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SEVERIN (H. H. P.) & TOMPKINS (C. M.). **Transmission of Radish-mosaic Virus by Aphids.**—*Hilgardia* **20** no. 11 pp. 191–198, 7 pls., 7 refs. Berkeley, Calif., 1950.

A mosaic disease is common in cultivated radish in the San Francisco Bay districts of California and also occurs in wild radish, which probably serves as a reservoir of the virus. An account is given of investigations on its transmission by Aphids in which it was transmitted by *Brevicoryne brassicae* (L.), *Rhopalosiphum pseudobrassicae* (Davis), *Myzus ornatus* Laing and *M. persicae* (Sulz.), which breed on radish under natural conditions, and by nine other species that do not. *B. brassicae*, *R. pseudobrassicae*, *M. ornatus* and *M. persicae* infected 36, 12, 10 and 48 per cent. of healthy plants when transferred to them from infected plants on which they had been reared, and 12, 56, 28 and 48 per cent. when reared on healthy plants, starved for 2–3 hours and then allowed to feed singly on infected plants for 0·5–10 minutes. Aphids reared on infected plants transmitted the virus for only three hours after leaving them. Mechanical inoculation resulted in 68 per cent. infection. It is concluded that the virus is of the non-persistent type [*cf. R.A.E.*, A **29** 26].

ESSIG (E. O.). **A new Aphid on Lettuce (Homoptera).**—*Pan-Pacif. Ent.* **25** no. 4 pp. 151–153, 1 fig. San Francisco, Calif., 1949.

Large numbers of an Aphid, here described from alate and apterous viviparous females as *Macrosiphum barri*, sp. n., were found on the flower stalks and seed heads of lettuce at a place in Idaho in September 1947 and July 1948. This Aphid, which was less abundant in 1949, may be the one that damaged seed lettuce at the same place in 1927. It was also reported from lettuce in Colorado in 1947 and Illinois in 1948.

FRICK (K. E.). *Liriomyza langei*, **a new Species of Leaf Miner of economic Importance in California (Diptera : Agromyzidae).**—*Pan-Pacif. Ent.* **27** no. 2 pp. 81–88, 2 figs., 10 refs. San Francisco, Calif., 1951.

Descriptions are given of the adults of both sexes, larva and puparium of *Liriomyza langei*, sp. n., which has been reared from leaf mines on peas in California and Washington and on sugar beet, spinach, celery and aster in California, and has also been found in Idaho. It is the species that has previously been recorded in California as *L. orbona* (Mg.) or *L. flaveola* (Fall.) [*R.A.E.*, A **34** 57 ; **35** 113 ; **37** 191, 473] ; characters of the adults and puparium differentiating *L. orbona* from it are described. The mines are serpentine and are often so twisted as to cross many times, sometimes having a blotch-like appearance. Notes on the mines observed in different food-plants are given.

GHESQUIÈRE (J.). **Contribution à l'étude du genre** *Aneristus* **Howard (Hym. Chalcidoidea Aphelinidae).**—*Bull. Ann. Soc. ent. Belg.* **85** pt. 5–6 pp. 156–167, 4 figs. Brussels, 1949.

Descriptions are given of *Aneristus coccidarum*, sp. n., from four females reared from *Ceroplastes destructor* Newst. on coffee in the Belgian Congo, and of *A. saissetiae*, sp. n., from a single male from *Saissetia* sp. on guava in French Equatorial Africa, followed by a list of the 11 species of the genus showing their hosts and distribution and a key to the ten of which the females are known. All are parasites of Coccids.

CHERIAN (M. C.) & MARGABANDHU (V.). *Trichogrammatoidea nana* **Zehnt. (Hym. Chalcidoidea)—an Egg Parasite of the Sugarcane Borer** *Argyria sticticraspis* **Hampson : a new Record from south India.**—*J. Bombay nat. Hist. Soc.* **48** no. 1 pp. 157–158, 9 refs. Bombay, 1949.

The authors state that *Trichogrammatoidea nana* (Zehnt.) was recently reared from eggs of the sugar-cane borer, *Chilotraea infuscatella* (Sn.) (*Argyria sticticraspis* Hmps.), in Madras, this being its first record from that host in India. They review its distribution and hosts from the literature, and give brief notes on its bionomics, together with a description of the adult female and the characters separating the genus from related ones.

VERMA (S. C.) & MATHUR (P. S.). **The epidermal Characters of Sugarcane Leaf in Relation to Insect Pests.**—*Indian J. agric. Sci.* **20** pt. 3 pp. 387–389, 2 pls., 4 refs. Delhi, 1950.

Varieties of sugar-cane in which the mid-ribs of the leaves are strongly lignified have been shown by earlier investigators in India to be the most resistant to attack by *Scirpophaga nivella* (F.). The studies here recorded showed that varieties with many bulbous spines (denticules) along the lower surface of the mid-ribs are considerably less susceptible to attack by the larvae than those in which the spines are less numerous.

FREEMAN (J. A.). **Pest Infestation Control in Breweries and Maltings.**—*J. Inst. Brew.* **57** no. 5 pp. 326–337, 16 refs. London, 1951.

The conditions under which the malting of barley is carried out favour the development of insect pests, but the insects cause little or no interference with the actual malting process. In the course of inspection of 117 maltings in Britain in 1943–51, over 80 species of insects and mites were found, the most important being *Calandra granaria* (L.), *Trogoderma granarium* Everts, *Oryzaephilus surinamensis* (L.) and *Tribolium castaneum* (Hbst.). *Ptinus tectus* Boield., although common, only occasionally reached epidemic proportions. The others were scavengers, mould feeders, predators and parasites, and few of these increased sufficiently to require control, though their presence was often a sign of poor hygiene or undue toleration of the major pests ; *Hofmannophila pseudospretella* (Staint.) and *Tenebrio molitor* L., both of which need long periods to complete their life-cycle, were indicators of bad hygiene.

The author gives short accounts of the bionomics of the important pests and of methods of detecting and controlling infestation by them. The introduction of insects in barley into maltings is largely avoided if the grain is harvested by combine or threshed directly into clean fumigated sacks and conveyed directly to the maltster's store without lying in other grain storages. Home-grown grain, which is almost exclusively used at present, is much less infested than imported grain, but the increasing storage of grain by farmers instead of storage in the rick, which offered safety from storage insects, increases the likelihood of infestation. Infestation can be prevented by the inspection of incoming grain and bags and the refusal or treatment of infested material, and by attention to hygiene and building construction, to prevent the accumulation of grain or dust in inaccessible places or the presence of cracks or other hiding places for the insects. Grain should be stored in bags stacked away from walls or in concrete silos, and not in bulk on floors or in bins that cannot be sealed for fumigation. Mechanical and physical methods of control comprise sieving infested grain and heating empty bags to a temperature of 140°F. for three minutes, preferably with live steam or damp hot air ; the treatment of barley by heat is probably inadvisable, as it may prevent germination. Chemical control is mainly by means of contact insecticides or fumigants. Adults of

C. granaria are very susceptible to γ BHC (benzene hexachloride), less so to DDT and fairly so to pyrethrins, and all stages are susceptible to methyl bromide and mixtures of ethylene dichloride and carbon tetrachloride, but there is slight resistance to hydrocyanic acid gas. *O. surinamensis* is difficult to control. In small-scale tests, the most immediate effects on the adults were obtained by the use of pyrethrum (1·3 per cent. pyrethrins) and derris dusts ; 5 per cent. DDT dust was more effective than 0·5 per cent. γ BHC, and the insect bred readily in grain dusted with 2·5 parts per million of γ BHC. It is killed by the direct action of DDT smoke, but the residual effect is not enough to give further control, and fumigation of sound buildings with 30 oz. HCN per 1,000 cu. ft. for 36 hours has shown some survivors. Control is probably best effected with pyrethrum sprays.

Larvae of *Trogoderma*, which, in Britain, is almost exclusively confined to maltings, are resistant to DDT and only slightly affected by γ BHC, and are best controlled with pyrethrum sprays and dusts. The adults are susceptible to DDT and γ BHC, so that measures designed to kill the adults before they oviposit should eradicate a population. The larvae are as resistant to HCN as *Calandra*, but methyl bromide is particularly effective owing to its powers of penetration. *Tribolium* is susceptible to all the common insecticides, so that treatments applied against other pests should control it, and *Ptinus* is generally susceptible to DDT, γ BHC and pyrethrum sprays and dusts, but its habits of tunnelling in the food or remaining deep in crevices in the building necessitate repeated control measures.

Methods of applying the insecticides and their relative value and convenience are discussed in some detail. Contact insecticides can be applied as dusts, sprays or smokes, and crawling insects can be trapped by means of insecticidal or adhesive barriers. Fumigation should be applied when all other measures have failed or to reduce an excessive insect population to a level at which the other measures will hold it in check. Control measures should be applied particularly in midsummer, when malting ceases in ordinary maltings.

CLEMENTS (A. N.). **A Revision of *Diparopsis* Hmps. (Agrotidae, Lepidoptera).**—*Bull. ent. Res.* **42** pt. 3 pp. 491–497, 12 figs., 8 refs. London, 1951.

Following the observation of differences in the structure of the frontal processes of moths considered to be *Diparopsis castanea* Hmps., which has frequently been recorded as a serious pest of cotton in various parts of Africa, a study was made of specimens in the British Museum identified as *D. castanea* or *D. tephragramma* B.-B. (the only other species of the genus hitherto known), supplemented by additional material from Africa. As a result, four distinct species were recognised, differing not only in frontal process and male genitalia, but also in wing pattern, food-plants and distribution. These are *D. castanea*, *D. tephragramma* and two described as *D. perditor* and *D. gossypioides*, spp. n. *D. perditor* and *D. castanea* both attack cotton and have hitherto been confused, but differ in distribution. *D. perditor* is recorded from the Anglo-Egyptian Sudan, Ethiopia, Aden, Nigeria, the Gold Coast, Sierra Leone and Senegal, and *D. castanea*, which also feeds on *Cienfuegosia hildebrandtii*, from Nyasaland, Uganda, Northern Rhodesia, Mozambique and Natal, though it also occurs in other parts of South Africa and in Southern Rhodesia. The record from Uganda is based on a single specimen, and *D. castanea* does not attack cotton there. *D. gossypioides* is described from a male reared from a larva found feeding on *Gossypioides kirkii* in Tanganyika, and records of *D. castanea* from that Territory may be referable to it. The food-plant of *D. tephragramma*, which appears to be confined to Angola, is unknown. Modifications of the original descriptions of *D. castanea* and *D. tephragramma* and a key to the adults of the four species are included.

HOWE (R. W.) & BURGES (H. D.). **Studies on Beetles of the Family Ptinidae. VI. The Biology of** *Ptinus fur* **(L.) and** *P. sexpunctatus* **Panzer.**—*Bull. ent. Res.* **42** pt. 3 pp. 499–511, 1 pl., 4 figs., 22 refs. London, 1951.

The following is substantially the authors' summary of this part of a series [*cf. R.A.E.*, A **40** 4, etc.]. The development of *Ptinus fur* (L.) and *P. sexpunctatus* Panz. was studied at several temperatures and 70 per cent. relative humidity. Development of *P. fur* was most rapid at about 23°C. [73·4°F.], at which temperature it was completed in a mean of 132·1 days on fishmeal. *P. sexpunctatus* developed most rapidly at a little below 30°C. [86°F.], development being completed in an average of 110 days on wheatfeed. Eggs of *P. sexpunctatus* hatched at 30°C., but not those of *P. fur*, for which species that temperature is near the maximum for development. Larvae of *P. fur* reared on fishmeal normally moulted three times at 23°C., but some passed through an extra moult. At low temperatures, some mature larvae of *P. fur* enter a well-defined diapause in the cocoon. This lasted for about 220 days after normal larvae had pupated at 23°C. and about 280 days at 20°C. [68°F.]. Some larvae of *P. sexpunctatus* also diapaused at this stage. In experiments, the development periods of diapausing and non-diapausing larvae overlapped to form a continuous series. Some adults of *P. sexpunctatus* pass through a period of quiescence before leaving the cocoons ; at 23°C., this lasted for a mean of 43·5 days for adults reared on fishmeal and 103 for those reared on wheatfeed. In *P. fur*, the pre-emergence period lasted 30–60 days, which is considerably longer than that of other warehouse Ptinids studied [*cf. loc. cit.*]. Both species developed more quickly on wheatfeed than on fishmeal, but adults reared on fishmeal were the heavier. The adults survived for several months and required both food and water. The egg output was small, the mean number of eggs laid per female at 25°C. [77°F.] being 38·6 for *P. fur* and 21·3 for *P. sexpunctatus*. The latter survived the winter in an unheated outbuilding in southern England, and might become a pest on some foods. *P. fur* is unlikely to occur in large numbers, owing to its long development period, small egg output and tendency to larval diapause.

A modification by H. E. Hinton of Manton's key to Ptinid larvae [**33** 135] to include *P. sexpunctatus* is appended.

WILLIAMS (C. B.). **Comparing the Efficiency of Insect Traps.**—*Bull. ent. Res.* **42** pt. 3 pp. 513–517, 5 refs. London, 1951.

The following is virtually the author's summary. Three light-traps were tested for relative efficiency at Rothamsted by placing them at three different sites in a wood and moving them daily so that over each period of three nights, each trap had been once in each position. The actual numbers of moths caught were converted to a logarithmic scale and the mean log. (log. of the geometric mean catch) was used for comparison. By analysis of variance, it was possible to show what portion of the differences between the catches was due to the difference between the sites, to the difference between the nights, and the difference between the traps.

HASKELL (G.). **Studies with Sweet Corn. The Frit Fly Problem.**—*Bull. ent. Res.* **42** pt. 3 pp. 519–526, 1 pl., 13 refs. London, 1951.

All varieties of sweet maize grown in England are attacked in the seedling stage by *Oscinella frit* (L.) [*cf. R.A.E.*, A **37** 45], and observations of the damage caused by this Chloropid were made on experimental crops in Surrey during 1946–49. The amount of damage sustained by open-pollinated, hybrid and inbred varieties was found to differ ; furthermore, some varieties from the United States or Canada were more susceptible than others. Liability to attack was not associated with adaptability to English conditions or with the date on which most heads reached maturity. Severity of attack was influenced by the sowing date ; the most suitable one varied with variety and season, but, in general, sowing in late May was followed by the least injury. The distribution of infested plants within a crop appeared to be random ; plants grown in a line extending outwards in the direction of the prevailing wind from a central square mass of pollinator plants were more damaged than those in lines extending in other directions, but there was no regular decrease in incidence with distance from the central mass. Possible methods of preventing and controlling attack are briefly reviewed.

SOLOMON (M. E.). **Control of Humidity with Potassium Hydroxide, Sulphuric Acid, or other Solutions.**—*Bull. ent. Res.* **42** pt. 3 pp. 543–554, 1 graph, 26 refs. London, 1951.

Papers by Buxton [*R.A.E.*, A **19** 712] and Buxton & Mellanby [**22** 489] have led to the increasing use of solutions of sulphuric acid or potassium hydroxide for controlling atmospheric humidity in biological experiments. The present paper gives convenient access to up-to-date and accurate data on these and other solutions useful for humidity control, and indicates some of the difficulties associated with their use and convenient methods of preparing them.

COLLYER (E.). **The Separation of** *Conwentzia pineticola* **End. from** *Conwentzia psociformis* **(Curt.), and Notes on their Biology.**—*Bull. ent. Res.* **42** pt. 3 pp. 555–564, 1 pl., 4 figs., 12 refs. London, 1951.

Larvae of *Conwentzia pineticola* End. were observed in numbers preying on *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.) in orchards in Essex during August and September 1947 and subsequently in Kent. This Coniopterygid has sometimes been regarded as a biological race or variety of *C. psociformis* (Curt.), which was also present in the same counties, but a comparison showed that although the characters of the adults are variable and many intermediate forms occur, they can be separated on the number of antennal joints and venation when sufficiently large numbers are available. The larvae of *C. pineticola* could not be identified from the literature, but were consistently distinct from those of *C. psociformis*, larvae of succeeding generations were identical, and adults reared from them bred true ; furthermore, the eggs differed from those of *C. psociformis*. *C. pineticola* is therefore considered a distinct species, and descriptions are given of the egg, the first- and third -instar larvae, and the cocoon.

C. pineticola has several overlapping generations a year, and winter is passed by the prepupae in cocoons on or under the bark. The adults emerge in April, and all stages are present from May until November ; in 1947 and again in 1949, larvae were active as late as mid-December. The duration of development ranges from 16 days in midsummer to 36 in September. In summer, the cocoons are constructed on the leaves or occasionally on the twigs. The adults are long-lived, females surviving for up to eight weeks in the laboratory. The maximum number of eggs deposited per female was 107, laid between 12th September and 29th October. Up to eight eggs a day were laid during July–August and five in part of September, but the number decreased during October. The eggs are laid singly on the lower surface of the leaves or on the bark. The occurrence of *C. pineticola* was somewhat sporadic, and in Essex it was found only in association with outbreaks of *P. pilosus*. It was observed on apple, pear, plum, damson, cherry and walnut, and occasionally on neighbouring hedgerow plants. Adults of the overwintered generation that emerged in the laboratory and were provided with winter eggs of *P. pilosus* did not survive for long ; they apparently do not remain in the orchards in April, when these eggs are the only available food. Both larvae and adults feed almost entirely on mites. All stages, including the winter eggs, are attacked, but adult females are preferred.

C. psociformis was found in small numbers on fruit and other trees and bushes, especially hawthorn [*Crataegus*], in Essex and on *Buxus* in Kent. It has two generations a year and is not active after September. In Essex, it fed principally on *P. pilosus*. Other Coniopterygids that attack this mite in orchards are *Coniopteryx tineiformis* Curt. and *Semidalis aleyrodiformis* (Steph.).

BARNES (H. F.). **A new Gall Midge (Dipt., Cecidomyidae) predaceous on the Flour Mite,** *Tyroglyphus farinae* **(Deg.)**.—*Bull. ent. Res.* **42** pt. 3 pp. 565–566, 2 refs. London, 1951.

The species of *Trisopsis* of which larvae were found preying on *Tyroglyphus farinae* (Deg.) in laboratory cultures in Leningrad [*R.A.E.*, A **27** 319–320] is here described from adults of both sexes as *Trisopsis tyroglyphi*, sp. n. It is the only species of the genus known to feed on mites, though probably all are predacious. The circumstances in which the other species were first taken are briefly reviewed.

RIVNAY (E.). **Further toxicological Studies on Species of** ***Capnodis*** **in Israel.**—*Bull. ent. Res.* **42** pt. 3 pp. 567–573, 2 refs. London, 1951.

Investigations were begun in Israel in 1945 on the value of synthetic organic insecticides against species of *Capnodis* that attack stone-fruit trees, in an attempt to develop a simpler method of control than spraying with stomach insecticides [*cf. R.A.E.*, A **35** 215]. In preliminary tests for fumigant effect, dusts of BHC (benzene hexachloride containing about 13 per cent. γ isomer) were ineffective against larvae boring in twigs or roots, but in tests for contact effect in which neonate larvae were allowed to crawl for an hour on a layer of insecticide diluted 1 : 9 in sand and were then transferred to slits in pieces of wood, the percentages that survived were 3 and 0 for 3·5 and 5 per cent. BHC, 28·6 for 5 per cent. DDT and 0 for a mixture of 1 per cent. chlordan and 3 per cent. Thanite (believed to be mainly isobornyl thiocyanoacetate), as compared with 64·3 in the control. In a similar experiment in which the insecticides were first buried in small bags in the soil at depths of 4–6 ins. and left for varying periods, both DDT and the mixture of chlordan and Thanite were ineffective after 30 days, but 3·5 per cent. BHC was still toxic after 50. Since the newly hatched larvae seldom remain on the surface of the soil, but immediately move towards the roots [**33** 384], an attempt to simulate more natural conditions was made in 1948–49. A box with four compartments each containing a 1-in. layer of an insecticidal dust diluted 1 : 9 in sand between two layers of sand, each 4 ins. thick, was buried in the soil ; vertical samples through the three layers were taken periodically by means of a metal tube and the effectiveness of the dusts was tested by placing small pieces of almond twig in the lower layer of sand in the tube and a few recently hatched larvae on the upper one. The dusts were 5 per cent. BHC, dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] or methoxy-DDT (methoxychlor), and all gave complete protection after 33–327 days ; survival among the control larvae was low. A similar test with methoxy-DDT in a glass tube showed that the larvae were not repelled by the insecticide, many being found dead in the treated layer and some below it ; none entered the twig. Neither BHC nor methoxy-DDT at 5 per cent. was injurious to the roots of plum or peach when mixed 1 : 9 with sand, strewn on the ground and covered with soil.

Experiments with the adults were begun in 1945, when the beetles were allowed to feed on almond twigs that had been dipped one hour previously in suspensions of 0·5 per cent. lead arsenate, 0·7 per cent. cryolite or barium fluosilicate or 0·5 or 0·75 per cent. DDT or a dust containing 1 per cent. DDT. The percentage survival after 30 days on twigs treated with DDT was 33–48, whereas all the adults on twigs treated with the other materials were dead. In an orchard test in 1950, dusts containing 5 or 10 per cent. DDT or 5 per cent. BHC and sprays containing 0·5 per cent. DDT or methoxy-DDT as wettable powders gave only fair control when beetles were confined on branches treated 1–12 days previously, but 0·5 per cent. BHC as a wettable-powder spray permitted only 7 per cent. survival after 8 days and retained its toxicity for at least 12 days after application, being comparable in effectiveness with cryolite.

RAW (F.). **The Ecology of the Garden Chafer,** *Phyllopertha horticola* **(L.) with preliminary Observations on Control Measures.**—*Bull. ent. Res.* **42** pt. 3 pp. 605–646, 2 pls., 10 figs., 19 refs. London, 1951.

The following is substantially the author's summary of field and laboratory investigations in Britain, mainly in 1945–48. *Anomala* (*Phyllopertha*) *horticola* (L.) is widely distributed in England and Wales, but is more abundant in the west. Its natural habitat is permanent grassland of poor quality characterised by a diversity of flowering plants and a high proportion of weeds. The soil of the infested areas is invariably light, the land is usually hilly and the rainfall relatively high. It has a one-year life-cycle, and the adults emerge suddenly in May or June according to the weather [*cf. R.A.E.*, A **29** 110 ; **35** 165], the males some days before the females. Daily activity increases during the flight period, which lasts 3–4 weeks. Beetles fly only in warm, sunny weather.

The females lay an average of 14 eggs each. Fecundity is correlated with weight and is related to the food-supply of the larvae. In the field, the weight of the adults may be limited through exhaustion of their food-supply. Females will mate and lay fertile eggs without feeding. In general, feeding by the adult does not affect fecundity, but in one experiment, beetles fed on *Poterium sanguisorba* produced and laid more eggs than those fed on bracken, blackberry or grass or kept without food. Over 90 per cent. of the eggs are fertile ; fertility decreases with the age of the adult. The eggs hatch in about 22 days in the laboratory and 28 days in the field.

The spatial distribution and seasonal changes in population of *A. horticola* were studied over the whole period within an infested field in Somerset. The eggs are laid in the soil in groups, from which the larvae disperse. At the end of the feeding period, the larvae may be distributed at random, but there is some evidence that regrouping at feeding sites occurs. Most of the eggs are laid in the top 3 ins. of soil. The larvae feed in the root zone but penetrate deeper in winter to hibernate. The population fell in successive years within the area studied. Initially there was a higher infestation in part of the field where the turf was damaged by the larvae, but the relative intensity of the infestation changed and subsequently more eggs and larvae were found in part of the field where the turf was undamaged. Mortality was higher among larvae in the damaged part of the field. These population changes are related to a number of environmental factors that may account for them, in particular to dispersal of the adults, density of the vegetation, consolidation of the soil, soil moisture and predators. In a field in Dorset, birds reduced the larval population by 50 per cent. between 1st September and 1st November 1948.

A study of the effect of infestation upon the vegetation showed that damage was largely due to the destruction of the grasses [*cf.* **33** 155 ; **35** 165]. Weeds were unaffected, and there was no evidence of an increase of weed area by colonisation of bare patches resulting from damage. The grass, *Brachypodium pinnatum*, resisted attack owing to its tough rootstock. *Dactylis glomerata* and *Lolium perenne* were relatively resistant, and *Poa* spp. and *Festuca* spp. were damaged but regenerated when feeding stopped and the population declined. *Poterium sanguisorba*, a preferred food-plant, was more abundant in damaged areas, and its distribution may influence that of *A. horticola*. When infestation is severe and the grass roots are destroyed, the water-stable soil aggregates are broken down. The soil structure was restored when the grasses regenerated and also following consolidation by cattle.

Field populations were reduced by ploughing and by reseeding. Dusting with 3·5 per cent. benzene hexachloride at 70 lb. per acre during the flight period gave promising results against the adults when applied in favourable weather, but a 5 per cent. DDT dust applied at the same rate was greatly inferior in effectiveness and speed of action.

REYNOLDS (H. T.) & SWIFT (J. E.). **Control of *Petrobia latens* in the Imperial Valley of California.**—*J. econ. Ent.* **44** no. 5 pp. 642–645, 2 refs. Menasha, Wis., 1951.

Petrobia latens (Müller) [of which McGregor has found *P.* (*Tetranychina*) *tritici* (Ewing) (*R.A.E.*, A **10** 3 ; **23** 532) to be a synonym] was observed causing extensive damage to carrots and also injured onions and cantaloupe melons in the Imperial Valley of California in January 1950. Similar damage had occurred in 1948 and 1949. Infestation of carrots by this Tetranychid spreads rapidly through a field from small localised areas and results in yellowing and drying of the leaves. Two experiments on the control of the mite on carrots were carried out in 1950, and the following is taken from the authors' summary of the results.

Single applications of dusts of 1 per cent. parathion alone and with 85 per cent. sulphur, sulphur alone and 1 per cent. O,O-dimethyl S-(2-oxo-2-ureidoethyl) dithiophosphate [also known as S-mercaptoacetylurea O,O-dimethyl dithiophosphate], made with a rotary hand duster at 33–45 lb. per acre gave 94–98 per cent. reduction of population as compared with no treatment within seven days and maintained excellent control for 16 days, when parathion appeared to be losing its effectiveness. At temperatures ranging from 95 to more than 100°F., 10 per cent. p-chlorophenyl phenylsulphone and 10 per cent. 2,4-dichlorophenyl benzenesulphonate gave 89 and 83 per cent. reduction, respectively, in four days, and at temperatures of 85–90°F. they gave excellent control, but were slower in action ; 5 per cent. p-chlorophenyl phenylsulphone gave only fair control. A very slow-acting material, 10 per cent. p-chlorophenyl p-chlorobenzenesulphonate, gave 41 per cent reduction in four days and 80 per cent. in 16 days. In both experiments, 1–2 per cent. ethyl p-nitrophenyl thionobenzenephosphonate gave poor control.

KEISER (I.) & HENDERSON (C. F.). **DDT Spray Formulations for Control of White-fringed Beetles.**—*J. econ. Ent.* **44** no. 5 pp. 646–652, 9 figs., 5 refs. Menasha, Wis., 1951.

In view of the effectiveness of DDT against *Graphognathus* spp., investigations were carried out in Mississippi in 1945–48 on the persistence of residues from various spray formulations applied with a concentrated-spray machine, and their toxicity to the adults in the field. In tests of various solvents for solutions and emulsified solutions in 1945, xylene was less injurious to cotton foliage and resulted in higher DDT residues on it than any other material except a highly volatile proprietary petroleum solvent, and was selected for further use.

In 1946, emulsified solutions were applied in a weed field to give 5 lb. DDT with 5 U.S. quarts xylene or 10 lb. DDT with 10 U.S. quarts xylene in 6 U.S. gals. spray per acre, and suspension sprays to give 5 and 10 lb. DDT in 6 U.S. gals. spray per acre. Foliage samples taken immediately and after intervals of up to 37 days showed that the emulsions were more adhesive than either of the suspensions and the 10-lb. dosage better than the 5-lb. dosage of the same formulation, the stronger emulsion giving the highest residues. When the same sprays were applied to soy beans, there was little difference in residues in the absence of rain, but the emulsions were more persistent after rain, the stronger emulsion again resulting in the highest DDT residues on the foliage. Residues from suspensions were washed more rapidly from pea leaves than from soy bean.

In 1947, chemical analysis of residues obtained in the laboratory from applications corresponding to 1 lb. DDT in 2, 6 and 12 U.S. gals. spray per acre in xylene emulsion or in 2 U.S. gals. solution in kerosene or a mixture of xylene and summer oil showed approximately equal deposits of DDT, indicating that actual volume of spray was not a factor in obtaining adequate deposit and distribution of DDT. Examination of the deposits on glass plates showed that small globular crystals were associated with highly concentrated sprays and rapid evaporation and long needles with slower drying sprays, either emulsions with a quick-drying solvent and a comparatively large amount of water or solutions containing slower drying solvents. Field tests with adults of *Graphognathus* showed that the small globular crystals withstood weathering for 15 days better than the long needles. In a supplementary laboratory study with potassium-permanganate solution, droplet size was practically unaffected by concentration, but the number of droplets on the plates varied directly with the total quantity of spray (2, 6 or 12 U.S. gals. per acre). In 1948, three applications at 17-day intervals of 0·5 or 1 lb. DDT in 2, 3 or 6 U.S. gals. emulsion spray per acre all gave good kills of *Graphognathus* adults, and higher DDT residues were associated with the more concentrated sprays. In tests with the 1-lb. rate, 43–59 per cent. of the DDT applied to the foliage was lost in an initial three-day period with no rainfall.

SHERMAN (M.). **Chemical Control of Sweetpotato Insects in Hawaii.**—*J. econ. Ent.* **44** no. 5 pp. 652–656, 5 refs. Menasha, Wis., 1951.

The results are given of four field-plot experiments in Hawaii in 1950 on the effectiveness of nine insecticides applied to sweet potato by various procedures ; each was used at the same concentration throughout, and the amounts given are per 100 U.S. gals. The pests present were *Omphisa anastomosalis* (Gn.), which feeds in the stems, and the weevils, *Euscepes postfasciatus* (Fairm.) and *Cylas formicarius elegantulus* (Summers), which attack the stems and tubers. *Cylas* was not numerous, and the results against the two weevils are combined. In the first test, the soil was irrigated and allowed to soften, the slips were set in holes six inches deep into which 32 cc. insecticidal suspension or emulsion had been poured, and the plants and soil were sprayed 5, 10, 14, 16 and 18 weeks after planting. Treatment with 0·25 lb. 25 per cent. wettable lindane [at least 99 per cent. γ benzene hexachloride], 1 U.S. quart emulsion concentrate containing 25 per cent. aldrin [1,2 3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], 2 lb. 40 per cent. wettable chlordan, 2 lb. 50 per cent. wettable DDT or 2 lb. 40 per cent. wettable toxaphene controlled the weevils in the stems, though DDT was much inferior to the others, all but lindane controlled them in the tubers and all but chlordan, which was ineffective, gave excellent protection from *Omphisa*.

In the second test, the slips were immersed in insecticidal suspension for 30 seconds before planting and the plots were sprayed five times as in the first test. Lindane, aldrin, DDT and toxaphene and 0·25 lb. parathion 25 per cent. wettable powder were effective against *Omphisa*, 7·2 lb. 90 per cent. wettable cryolite was somewhat less effective, and chlordan, 2 lb. 50 per cent. wettable methoxy-DDT (methoxychlor) and 0·25 lb. 25 per cent. wettable dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] were ineffective. Stem infestation by the weevils was high on plots treated with cryolite or methoxy-DDT, but damage to the tubers was significantly less in all the treated plots than in untreated ones.

In the third test, in which the nine insecticides were applied five times as sprays only, lindane, DDT and parathion were the only ones that controlled *Omphisa*. None of the treatments protected the stems from weevil attack, but damage to the tubers was significantly less in all the treated plots than in the untreated ones. In the fourth, in which the slips were dipped and no sprays were applied, none of the nine insecticides gave effective control of *Omphisa* or of the weevils in the stems, and damage to the tubers of plants treated with DDT, dieldrin or chlordan, though less than that for the other treatments and significantly less than that in untreated plots, was too great for the results to be considered satisfactory. None of the treatments resulted in appreciable residues in the tubers or affected their flavour when cooked.

BALOCK (J. W.) & LINDGREN (D. L.). **Toxicity of various Compounds as Fumigants to Eggs and Larvae of the Oriental Fruit Fly.**—*J. econ. Ent.* **44** no. 5 pp. 657–659, 1 graph. Menasha, Wis., 1951.

Methyl bromide is toxic as a fumigant to *Dacus ferrugineus dorsalis* Hend. only at concentrations injurious to some products, and in a search for other materials with less injurious effects, 53 fumigants or mixtures of fumigants were tested in Hawaii for toxicity to the naked eggs and third-instar larvae. The results are given in tables and showed that ethyl thiocyanate, methyl thiocyanate, propylene oxide, 3-chloro-2-methylpropene, 1,1-dichloro-1-nitroethane, technical chlorobromopropene (mostly 1-chloro-3-bromopropene), allyl bromide, allyl alcohol, the ethyl ester of chloroacetic acid, methyl bromide and hydrocyanic acid gas were more toxic to the larvae than to the eggs, and ethylene dichloride, 1-bromo-2-chloropropane and a mixture of methyl bromide, ethylene dichloride and carbon tetrachloride were more toxic to the eggs than to the larvae. Chloroacetonitrile, methyl iodide, methyl thiocyanate, 1-bromo-2-chloroethane, ethylene dibromide, acrylonitrile, chlorobromopropene, 1,3-dichloropropene and the ethyl ester of chloroacetic acid were extremely toxic to both stages. In most instances, older eggs were more resistant to fumigation than younger ones.

SHAW (J. G.) & ORTIZ (M.). **Dips for the Citrus Blackfly as a possible Treatment for Mexican Limes boxed for Export.**—*J. econ. Ent.* **44** no. 5 pp. 660–665, 1 fig., 3 refs. Menasha, Wis., 1951.

For several years, living immature forms of *Aleurocanthus woglumi* Ashby have been intercepted on the Mexican border of the United States on foliage included with Mexican sour limes, and investigations were therefore made to develop tank dips for treatment of boxed limes to prevent the introduction of the Aleurodid. Boxes of limes interspersed with foliage bearing pupae of *A. woglumi* were immersed for five minutes in various light-medium oil emulsions, which were constantly agitated, and the fruits and leaves were then removed and dried, after which the fruits were stored for 40 days at room temperature and examined at 10-day intervals, and the leaves kept in jars at 77°F. and 60–75 per cent. relative humidity and examined after 11–12 days, when emergence had ceased. Commercially prepared 1·5–3 per cent. oil emulsions, 1·67 per cent. emulsive oil with cubé, and 3 per cent. kerosene emulsion caused significant losses of fruits, and the first two affected the flavour of the juice ; 3 per cent. oil emulsion did not always give satisfactory control, but no adults emerged when cubé (4·2 per cent. rotenone) was added at 3·9 oz. per U.S. gal. oil.

Further tests were made with two proprietary process oils of high paraffinicity and about 88–93 per cent. unsulphonated residue, referred to as Oil C (viscosity 58–60 secs.) and Oil P (viscosity 100–105 secs.). These were emulsified with one-tenth of their quantity each of sorbitan monolaurate and a polyoxyalkylene derivative of sorbitan monooleate, with dodecyl toluene sulphonate as a wetting agent. Emulsions of 1·5 and 2 per cent. oil remained stable throughout the treatment and for several weeks of storage. Oil P at 1–3 per cent. and Oil C at 1·5 or 2 per cent. (the lower concentrations used alone and with cubé) did not injure the fruits or affect the flavour, and all but the 1 per cent. emulsion without cubé gave complete kills of mature pupae (though only small numbers were available in some tests) and would probably give adequate protection against accidental introduction.

In preliminary tests, emulsions containing allethrin [synthetic allyl homologue of cinerin I] or pyrethrum extract prepared with the same emulsifiers and wetting agent gave promising results. Complete mortality of pupae without harm to the fruits or their flavour was given by 0·05 and 0·075 per cent. allethrin (75 per cent. pure) and by 0·02 per cent. pyrethrins.

WYLIE (W. D.). **Insecticide Tests against Plum Curculio.**—*J. econ. Ent.* **44** no. 5 pp. 665–668. Menasha, Wis., 1951.

In an attempt to find more satisfactory insecticides than lead arsenate for the control of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] on peach in Arkansas, adult weevils were caged on different dates on trees that had been sprayed with various insecticides. All spray quantities are given per 100 U.S. gals., and all sprays contained 6 lb. zinc sulphate and 8 lb. hydrated lime as a fungicide, unless otherwise indicated. In 1949, treatments were applied on 1st or 21st April or 12th May, and 5 lb. wettable sulphur was included in all sprays but one in May. Parathion at 0·25 lb. and chlordan at 1 lb. gave complete mortality and were the most effective materials tested, but when the results for all dates were combined, were not significantly better than 5 lb. BHC (benzene-hexachloride powder containing 6 per cent. γ isomer), 2 lb. toxaphene or 6 lb. lead arsenate, and all treatments but 2 lb. lead arsenate were significantly better than none. The addition of 1 lb. DDT significantly improved the spray of 2 lb. lead arsenate and this material was much more effective in May than in April, possibly owing to the higher temperatures. In a subsidiary test, BHC was more effective when zinc sulphate and lime were omitted. In a further application on 25th May, 0·12 lb. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] gave complete mortality, 0·12 lb. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] gave only 65 per cent. and 4 lb. DDT was ineffective. The last application was made on 16th June, when 0·25 lb. aldrin, dieldrin or parathion, the last with or without zinc sulphate and lime, and 1 lb. chlordan, with or without zinc sulphate and lime, all gave good control of weevils (presumably of the first generation) exposed on the day of treatment, but only dieldrin retained considerable toxicity after 13 days. Chlordan and parathion were slightly more effective when zinc sulphate and lime were omitted.

In 1950, 0·25 lb. dieldrin was the most effective material tested, giving complete mortality in several tests, and methoxy-DDT (methoxychlor) at

2 lb. gave excellent results. The addition of an adhesive appeared to decrease the effectiveness of lead arsenate, but when it was omitted there were no significant differences between dieldrin, methoxy-DDT and lead arsenate against weevils caged a week after treatment, all giving moderately effective and significant control. Parathion, BHC and aldrin were less satisfactory.

MARSHALL (G. E.). **White Grub Control in Strawberries.**—*J. econ. Ent.* **44** no. 5 pp. 668–671. Menasha, Wis., 1951.

The establishment of strawberry fields on newly-broken ground in Indiana is possible only if white grubs [*Lachnosterna*] are controlled, and attempts were therefore made to find materials that would kill them without incorporating objectionable residues into the soil or reducing the high productive capacity inherent in new soil. Chlordan, DDT, BHC (benzene hexachloride) and lead arsenate, all of which had been shown to control soil insects, were tested in 1948–50 in three sets of field plots situated several miles apart. BHC (12 per cent. γ isomer) was applied to the sod before ploughing or disked into the ploughed soil and gave consistently satisfactory results when applied at 30·2 lb. per acre by either method. The addition of 7·5 lb. 50 per cent. wettable DDT to 15·12 lb. BHC per acre did not result in improved production and might involve the accumulation of residues in the soil. Chlordan applied immediately before ploughing gave poor results in 1948, but proved much better in 1949, when it was used at 24·5 lb. 40 per cent. compound per acre. It was necessary to work lead arsenate very thoroughly into the soil if the newly set plants were to become established, and it resulted in poorer crops than the other materials. It is concluded that BHC is the most promising of the materials tested.

BARNES (M. M.). **Studies with Acaricides for Control of Mites in Apple and Pear Orchards in southern California.**—*J. econ. Ent.* **44** no. 5 pp. 672–684, 15 refs. Menasha, Wis., 1951.

The following is based on the author's introduction and summary. The continued use of DDT in sprays for the control of the codling moth [*Cydia pomonella* L.] on apple and pear in southern California has been accompanied by the development of injurious populations of several species of mites that were previously of little or no importance [*cf. R.A.E.*, A **39** 237]. These include *Tetranychus bimaculatus* Harvey, *T. multisetis* McG., *T. pacificus* McG., *T. mcdanieli* McG., *Paratetranychus pilosus* (C. & F.) and *Bryobia praetiosa* Koch on apple and *T. pacificus* and *B. praetiosa* on pear, on which *T. bimaculatus* has also become a serious problem where certain types of orchard cover are present.

The results are given of tests carried out in 1947–50 with 18 acaricides for the control of *T. bimaculatus*, *P. pilosus* and *B. praetiosa* on apple and *T. pacificus* and *T. bimaculatus* on pear. In preventive sprays against *T. bimaculatus* on apple in the absence of reinfestation from the orchard cover, DMC (1,1-bis(p-chlorophenyl)ethanol), 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite and schradan (octamethyl pyrophosphoramide) were equally effective and followed in order of decreasing effectiveness by p-chlorophenyl p-chlorobenzenesulphonate, p-chlorophenyl phenylsulphone and EPN (ethyl p-nitrophenyl thionobenzenephosphonate). Parathion was as effective as EPN and more so than dicyclohexylamine dinitro-o-cyclohexylphenate, which was superior to 2,4-dichlorophenyl benzenesulphonate. Against *P. pilosus*, 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite, DMC, EPN, schradan, 2,4-dichlorophenyl benzenesulphonate and p-chlorophenyl phenylsulphone were equally effective and more so than p-chlorophenyl-p-chlorobenzenesulphonate and parathion, which were equal in value, and dicyclohexylamine dinitro-o-cyclohexylphenate, which was the least effective. Against *B. praetiosa*, dicyclohexylamine dinitro-o-cyclohexylphenate, parathion and DMC were equal and more effective than p-chlorophenyl p-chlorobenzenesulphonate and 2,4-dichlorophenyl benzenesulphonate ; 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite and p-chlorophenyl phenylsulphone were inferior to any of these, but more effective than EPN.

When applied in preventive schedules against *T. bimaculatus* on pear trees subjected to reinfestation from the orchard cover, p-chlorophenyl p-chlorobenzenesulphonate and 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite were equally effective, and p-chlorophenyl phenylsulphone, EPN, 2,4-dichlorophenyl benzenesulphonate and parathion progressively less so.

O,O-dimethyl S-(2-oxo-2-ureidoethyl) dithiophosphate, S-carbamylmethyl O,O-dimethyl dithiophosphate, S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate, S-(1,2-dicarbethoxyethyl) O,O-diethyl dithiophosphate and S-(1,2-dicarbomethoxyethyl) O,O-diethyl dithiophosphate were sufficiently effective as acaricides to be worth further study, but 1,1-bis(x-chlorophenyl)ethane and O-(2-chloro-4-nitrophenyl) O,O-dimethyl thiophosphate were less effective. On apple fruits, di(p-chlorophenoxy)methane caused russetting and p-chlorophenyl p-chlorobenzenesulphonate blackening of the epidermis in the stem pit area, and on pears, alkyl (mainly lauryl) 2-thiazolinyl sulphide caused fruit spotting. These injuries were sufficiently severe to preclude the use of the compounds in the formulations and at the dosages tested. Applications of 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite caused slight russetting of pears.

SMITH (E. H.). **Control of Peach Tree Borer and Lesser Peach Tree Borer in New York.**—*J. econ. Ent.* **44** no. 5 pp. 685–690, 4 figs. Menasha, Wis., 1951.

Peach trees in New York are attacked by *Aegeria* (*Sanninoidea*) *exitiosa* Say and *A.* (*Synanthedon*) *pictipes* G. & R. The first of these is usually controlled by three applications of 3 lb. 50 per cent. DDT wettable powder per 100 U.S. gals. made at 21-day intervals from about 15th July [*cf. R.A.E.*, A **37** 386–387], but this treatment has the disadvantage that the last application is made when the dense foliage renders spraying of the trunks difficult, and it does not control *A. pictipes*.

A. exitiosa attacks the trunks mainly below soil level, and the presence of wounds in the bark is not necessary for its establishment. Most individuals have a life-cycle of one year, but about 30 per cent. require two years to complete development, and these are more injurious and more difficult to control during their second year. Adults emerge during July and August. *A. pictipes* attacks any part of the trunk or branches, usually at points already injured and above soil level, completes its life-cycle in one year and gives rise to adults from late May until early autumn.

In 1949, when 2, 4 or 6 lb. 50 per cent. wettable DDT and 2 and 4 lb. 15 per cent. wettable parathion per 100 U.S. gals. were applied to the trunks and scaffold branches on 13th July and 4th and 30th August, all treatments but 2 lb. DDT powder gave excellent control of larvae of *A. exitiosa* of the current year, but even 6 lb. DDT powder was not very effective against those in the second year. Control of *A. pictipes* was less satisfactory with all treatments, but parathion was more effective than DDT. In 1950, sprays of 2 lb. 15 per cent. parathion were applied in the same manner on 22nd June, when 15 per cent. of the adults of *A. pictipes* had emerged, on 12th July, when the earliest larvae had reached the fifth instar, on 3rd August, when sixth-instar larvae were present, or on all three dates. Each of the individual applications reduced the number of larvae per tree by over 50 per cent., and all three reduced it by 96 per cent. The last two applications coincided with the first two recommended against *A. exitiosa*.

A programme of four applications of parathion is suggested for control of both species, and since parathion is also used against other pests of peach, they might be integrated into a general spray schedule.

Sloan (M. J.), Rawlins (W. A.) & Norton (L. B.). **Residue Studies on DDT and Parathion applied to Lettuce for Control of the Six-spotted Leafhopper.**—*J. econ. Ent.* **44** no. 5 pp. 691–701, 30 refs. Menasha, Wis., 1951. **Factors affecting the Loss of DDT and Parathion Residues on Lettuce.**—*T. c.* pp. 701–709, 2 graphs, 28 refs.

It is stated in the first of these papers that DDT is widely used on lettuce in New York for the control of *Macrosteles divisus* (Uhl.), which is the vector of the virus of lettuce yellows [*cf. R.A.E.*, A **37** 389]. Parathion has recently been found to give comparable control and is used to a limited extent. Sprays are normally applied four times at weekly intervals, and dusts about five times at intervals of 5–7 days. The investigations described were made to obtain information on residues remaining on the plants at harvest, and were carried out in connection with experiments on the control of the Jassid in 1949–50. Up to five or six applications were made at the usual intervals, beginning when the plants appeared. DDT was applied at 1 lb. per acre in a wettable-powder spray, 0·75 lb. per acre in 5–55 U.S. gals. emulsion spray or 1·75–2 lb. per acre in a 5 per cent. dust, and parathion at 0·075 lb. per acre as a wettable-powder spray and at 0·35–0·4 lb. as a 1 per cent. dust. The lettuces were analysed for spray residues at various intervals and at harvest. The results are shown in detail in tables, and the following is based on the authors' summary of them.

DDT spray deposits after the last application and at harvest were usually larger on plants receiving a greater number of sprays, but parathion was less consistent, probably because of the more complete disappearance of the accumulated deposits from the earlier applications. On plots that had received equal numbers of spray applications of DDT or parathion, a higher residue at the time of the last application usually resulted in a higher harvest residue. Shortening the interval between the last application and harvest on samples that had received equal numbers of applications increased the harvest residue consistently for DDT in oil emulsion and less consistently for DDT and parathion wettable-powder sprays.

Rain less than a day after application caused a marked reduction of the deposits from both DDT and parathion sprays. Greater accumulated rainfall between the last application and the harvesting of plots that received similar numbers of applications gave lower harvest residues in most of the DDT spray plots but was less consistent in the parathion spray plots, where losses from other sources were greater. Most of the residues at harvest were found on the lower leaves, which are left in the field when the lettuce heads are cut for market. The greatest DDT residue found on the heads when applications were continued until 11 days before harvest was less than 1 part per million, but when DDT treatments were continued until four days before harvest residues of up to 5·4 p.p.m. occurred on them. The greatest parathion residue found on the heads was 0·14 p.p.m., which occurred on a sample dusted three times, the last application being made 21 days before harvest.

The second paper comprises an account of studies to ascertain the proportions of the loss of deposit per unit weight of plant attributable to plant growth and weathering, respectively. The results are given in tables. All DDT and parathion residues per unit weight of plant were shown to decrease by 94–95 and over 99 per cent., respectively, when the period between the last application and harvest was 14 days. Growth alone accounted for some 73 per cent. of this decrease, and weathering for 78–82 and 99 per cent. actual loss of deposit per plant for DDT and parathion, respectively.

O'NEILL (W. J.). **DDT and Parathion for San Jose Scale Control.**—*J. econ. Ent.* **44** no. 5 pp. 709–711. Menasha, Wis., 1951.

Before the general adoption of DDT for the control of the codling moth [*Cydia pomonella* L.] on apple, the San José scale [*Quadraspidiotus perniciosus* (Comst.)] was such a serious orchard pest in Washington, that it was necessary to apply dormant or delayed-dormant sprays against it, and these sometimes injured the trees. Since DDT has been used, orchards that have received two or more cover sprays annually have had no increase in infestation by the Coccid, despite the omission of dormant sprays for 3–5 years. In orchards in which DDT has not been used and in stone-fruit plantings, in which DDT cover sprays are not normally applied, omission of the dormant sprays has resulted in significant increases in infestation.

In 1948, various treatments were tested against the Coccid in a heavily infested prune orchard. Single sprays of 1 lb. 25 per cent. wettable parathion per 100 U.S. gals. were applied on 21st April (green tip stage), 4th June (first cover spray) or 15th June (before the appearance of the crawlers on 18th June) and 2 lb. 25 per cent. parathion and 2 lb. 50 per cent. wettable DDT on 14th and 15th June, respectively. The DDT spray gave effective control, but was slow in action, so that some fruit marking occurred, and the parathion treatments gave very good control on all dates of application, killing large proportions of the gravid females and reducing the numbers of crawlers.

It is concluded that either material should control the scale if properly timed, and a combination of the two is suggested to prevent fruit marking under conditions of severe infestation.

STONE (M. W.) & FOLEY (F. B.). **Field Tests with Ethylene Chlorobromide on Wireworms.**—*J. econ. Ent.* **44** no. 5 pp. 711–713. Menasha, Wis., 1951.

In preliminary field tests in Ventura County, California, in 1950, ethylene chlorobromide was compared with ethylene dibromide as a soil fumigant for the control of larvae of *Limonius californicus* (Mannh.). The materials were used as 42 and 40 per cent. solutions, respectively, by weight of the technical products in a volatile organic solvent. In the first test, lima beans planted on 5th May were treated on 19th May with the two solutions at 8·5 U.S. gals. per acre, applied 7 ins. deep in the soil on both sides of the row 6 ins. from the plants, and examination of soil samples taken four days later showed that 85 per cent. of the larvae found in the rows treated with ethylene chlorobromide and 96 per cent. in those treated with ethylene dibromide were dead. No further wireworm damage occurred, and there was no indication that the plants had been adversely affected by the fumigants. In another test, cages containing moist soil, wheat and larvae of *L. californicus* were exposed in the ground for eight days at depths of 0–12 ins. and distances of 6–12 ins. from points at each of which 2 ml. solution was injected at a depth of 4 ins. Ethylene dibromide gave higher mortality in each case than ethylene chlorobromide, but the latter showed promise. When applied 7 ins. deep at 12-in. spacings to soil with a moisture content of 13·7–18·2 per cent. and maximum soil temperatures of 66–70°F. on 10th May, 11 U.S. gals. ethylene-chlorobromide solution per acre gave an average of 51 per cent. mortality after a week of larvae caged at depths of 0–16 ins., whereas 22 U.S. gals. of the same material gave 90 per cent. and 11 U.S. gals. ethylene-dibromide solution 70 per cent. Lima beans were planted in the plots before and after treatment. After treatment, the wireworm populations in the rows were significantly lower in treated than in untreated plots, showing that most of the larvae were near the surface within range of the fumes at the time of treatment. The lower dosage of ethylene chlorobromide did not increase the yield significantly, but the higher dosage and ethylene dibromide gave significant increases.

GOULD (E.) & HAMSTEAD (E. O.). **The Toxicity of cumulative Spray Residues in Soil.**—*J. econ. Ent.* **44** no. 5 pp. 713–717, 1 fig. Menasha, Wis., 1951.

Investigations were begun in West Virginia in 1948 on the cumulative effect in the soil of residues of various chemicals used against insects, fungi or weeds in orchards. All materials were applied 4–5 times in the spring of 1948 and again in 1949 directly to the soil of plots containing apple and peach trees with a normal cover crop programme, as suspensions or solutions or as powders that were watered in. DDT, parathion, a mixture of zinc sulphate and lime (3 : 4), BHC (benzene hexachloride), lead arsenate, micronised sulphur, Fermate [ferric dimethyl dithiocarbamate] and chlordan were applied at total yearly rates of 40, 5, 560, 80, 120, 250, 75 and 40 lb. per acre, respectively (based on applications of 1,000 U.S. gals. spray at normal concentrations per acre or somewhat more than average heavy commercial spraying) and at ten and 30 times these rates, and toxaphene and 2,4-D [2,4-dichlorophenoxyacetic acid] at 400 lb. and 400 gm. (ten times the normal rates) only.

All cover crops were eliminated by BHC and sulphur at the two higher rates, and BHC at the normal rate and chlordan at the highest rate caused marked early phytotoxicity, though growth recovered later in the season. Lead arsenate and zinc-lime at the higher rates and toxaphene also showed marked toxicity to the cover crop, but neither parathion nor Fermate had any apparent effect ; lead arsenate, DDT, chlordan and zinc-lime at normal rates were not injurious. There was a fairly close correlation between the amount of cover crop and the soil organic content.

Peach trees in plots treated with BHC or sulphur showed increased vigour, the increase being greatest in those receiving BHC at ten times the normal rate, and only those in soil treated with lead arsenate at the higher rates showed toxic effects. Apple trees in plots treated with BHC at all rates and chlordan at the higher ones showed significant increases in vigour. BHC at all rates and parathion and chlordan at the highest ones gave complete control of *Eriosoma lanigerum* (Hsm.) on the roots of established apple trees, and chlordan at ten times the normal rate appeared to approach the minimum effective dosage. New nursery stock survived in all treated plots but those receiving sulphur at any rate or BHC at the two higher ones.

Estimates of arthropod populations in the soil (mainly Collembola) showed that BHC and chlordan were extremely toxic, that DDT was slightly toxic at the normal rate and very toxic at the higher ones and that parathion was associated with increased populations at the normal rate, though it was toxic at the higher ones. The normal rates of Fermate, parathion, lead arsenate and 2,4-D and all dosages of zinc-lime were also associated with increases in population.

ALLEN (T. C.) & CASIDA (J. E.). **Criteria for evaluating insecticidal Phytotoxicity—Aerial Growth.**—*J. econ. Ent.* **44** no. 5 pp. 737–740, 1 graph, 12 refs. Menasha, Wis., 1951.

In the method described for estimating the stimulating or inhibiting action of insecticides on the aerial growth of plants, sections are cut from the stems of etiolated bean seedlings below the cotyledons and placed in petri dishes with the toxicant, glass wool and a nutrient solution. After storage in the dark or subdued red light for 36 hours, the sections are measured and compared with standard sections grown in solutions containing arsenic trioxide and 2,4-D (2,4-dichlorophenoxyacetic acid) and a phytotoxic index (percentage inhibition of growth due to the toxicant) is calculated. The rate of growth is affected by the acidity of the solution, which is therefore adjusted to pH 6. Certain insecticides, such as the organic phosphates, may alter the hydrogen-ion concentration by hydrolysis or degradation, and special precautions must be taken when such compounds are used. The insecticides may be prepared as solutions, suspensions or emulsions and added to the nutrient solution, or dusts or sprays can be applied directly to the sections in the petri dishes; sections can also be exposed to the insecticide apart from the nutrient solution.

The effect of certain chlorinated hydrocarbons on growth was studied under various conditions. Many caused highly significant stimulation. Technical DDT had an auxin-like activity, stimulating plant growth in an unbuffered nutrient solution containing no auxin and inhibiting it when an auxin (indole-3-acetic acid) was present. Methoxy-DDT (methoxychlor) and γ benzene hexachloride caused more stimulation than 2,4-D. The toxicity of certain organic acids related to 4,4′-dichlorodiphenylacetic acid showed that the order of phytotoxic action is similar for the mono and bis derivatives and varies with ring substituents. In all cases, the toxicity of the bis compound was greater than that of the corresponding monophenyl or monophenoxy analogue, and both the bis-phenyl and the bis-phenoxy compounds were highly toxic.

CASIDA (J. E.) & ALLEN (T. C.). **Criteria for evaluating insecticidal Phytotoxicity—Root Growth.**—*J. econ. Ent.* **44** no. 5 pp. 741–746, 2 figs., 19 refs. Menasha, Wis., 1951.

As root responses to chemicals of either stimulatory or inhibitory action differ from those of the aerial parts of plants [*cf.* preceding abstract], a rapid laboratory method for evaluating the effects of insecticides on root growth was developed. Cucumber seeds are immersed in water for an hour and allowed to germinate in the absence of light for 24 hours, after which seeds with roots 1–2 mm. long are selected. These are transferred to filter paper in petri dishes containing 5 ml. toxicant solution at pH 5, and incubated at room temperature in the absence of light for 36 hours, after which they are kept at 4°C. for at least 1–2 hours to reduce the rate of growth. The evaluation of toxic action is based on comparison of root length and weight with those for standard solutions of arsenic trioxide and 2,4-dichlorophenoxyacetic acid, and the percentage inhibition of growth in each of these ways is taken as a phytotoxic index, a separate index being calculated for each factor.

DDT and related compounds were used in a series of tests to demonstrate attainable results. Of the impurities known to exist in technical DDT, 2-(p-chlorophenyl)-1,1,1-trichloroethanol showed an inhibitory action that might explain field observations of DDT phytotoxicity. The toxic action of DDT might also be associated with the possible breakdown to 4,4′-dichlorodiphenylacetic acid, which appears to act by affecting the membrane permeability rather than by an auxin-like effect. Methoxy-DDT (methoxychlor) was the most inhibitory of the commonly used analogues of DDT tested. The hydrogen-ion concentration influenced the effect of DDT on root growth.

It is considered that the evaluation of toxicants should include the effect on the aerial parts of the plants and on the roots, and that the applicability of the methods described is more general than the specific studies reported.

BRONSON (T. E.) & DUDLEY jr. (J. E.). **Two systemic Insecticides for Control of the Pea Aphid.**—*J. econ. Ent.* **44** no. 5 pp. 747–750, 7 refs. Menasha, Wis., 1951.

In preliminary tests in Wisconsin in 1950 with schradan (octamethyl pyrophosphoramide) against *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)) on peas [*cf. R.A.E.*, A **39** 384–385], four-inch plants sprayed in a greenhouse with about 1 lb. 90 per cent. schradan per 100 U.S. gals. showed foliage injury, which became progressively worse for several days after treatment, but new growth appeared, and adult apterous Aphids placed on the plants 13 days after spraying showed 0, 50 and 100 per cent. mortality after 24, 48 and 72 hours, respectively. Mortality in the controls was 20 per cent. in 72 hours. Adult Aphids placed on similar plants sprayed three days previously showed 90 and 100 per cent. mortality in 24 and 48 hours with no mortality in the controls. When 0·2, 0·1 or 0·05 ml. 90 per cent. schradan in 30 ml. water was poured over the soil in the cans just before each seed was sown, the two higher concentrations caused marked foliage injury, but the lowest much less. The treatments caused complete mortality in 24 and 48 hours of Aphids placed on the plants 9 and 26 days after sowing, respectively. In tests in which the seeds were sprinkled with 25, 58, 80 or 134 gm. 90 per cent. schradan in 350 ml. aqueous solution per bushel a few hours before planting and stirred until the solution was uniformly distributed over them, the mortality of Aphids placed on the plants 13, 25 and 33 days later did not exceed 30 per cent. in 48 hours. When 268 or 358 gm. schradan with 4 or 8·75 gm. gum arabic, respectively, in 500 ml. aqueous solution per bushel of seed was used, the mortality percentages in 48 hours for Aphids placed on the plants were 100 after 13 days, 98–99 after 18 days, and 92 and 95, respectively, after 37 days. There was no mortality in the controls and no noticeable foliage injury due to treatment.

In field tests on peas, a commercial preparation containing 4lb. schradan per U.S. gal. was applied in 10 U.S. gals. water per acre with a mist blower to give 0·5 or 1 lb. chemical per acre on 14th June, when the plants were 5–6 ins. high, and sweep counts showed 98–100 per cent. reductions in population as compared with no treatment 9–12 days later and 84 and 100 per cent., respectively, after 18 days; a further application at 1 lb. per acre on 8th July, when the plants were about 20 ins. high, caused 91 per cent. reduction one day later and 96–100 per cent. after 18 days. There was no noticeable foliage injury. In other tests, a trialkyl thiophosphate [*cf.* **39** 385] was used as well as schradan. When pea seed was coated with these materials in 350 ml. aqueous solution per bushel and allowed to dry before being sown at the rate of 4 bushels per acre, observations 47–61 days later showed that schradan at a rate giving 1,000 gm. active ingredient per acre was considerably more effective against the Aphid than schradan at 125 or 500 gm. and the trialkyl thiophosphate at 500 gm. per acre, and that 500 gm. schradan with 8·75 gm. gum arabic was almost equal to 1,000 gm. without it. In a similar test, observations 30–47 days after treatment showed that 500 gm. schradan, alone and with 8·75 gm. gum arabic, and 1,000 gm. schradan per acre were very effective for 36 days, but were decreasing in value by the 47th day. Both were considerably more effective than 250 gm. schradan and somewhat more effective than 500 gm. trialkyl thiophosphate, and there was no noticeable foliage injury. There was again little difference between 500 gm. schradan with gum arabic and 1,000 gm. without it.

It is concluded that for seed treatment, at least 500 gm. schradan (about 1 lb.) per acre is required to give 80 per cent. control of the Aphid and that effectiveness is enhanced by the use of gum arabic.

GAINES (J. C.), IVY (E. E.) & KING (C. E.). **Toxicity of certain Phosphorus Compounds to Cotton Insects.**—*J. econ. Ent.* **44** no. 5 pp. 750–753, 2 graphs, 5 refs. Menasha, Wis., 1951.

Since TEPP (tetraethyl pyrophosphate) and parathion, which are used extensively for the control of Aphids and mites on cotton in Texas, are very toxic to the higher animals, laboratory and field tests were carried out at College Station during 1950, in which S-(1,2-dicarbethoxyethyl) O,O-dimethyl dithiophosphate (TM-4049), S-(1,2-dicarbomethoxyethyl) O,O-diethyl dithiophosphate (TM-4018) and O-(2-chloro-4-nitrophenyl) O,O-dimethyl thiophosphate (TM-4124) were compared with other materials for the control of several of the pests concerned. Spray emulsions were prepared from miscible oil concentrates, and dusts by diluting concentrated dusts with an inert clay.

In the laboratory, all three compounds proved less toxic than either TEPP or parathion to *Septanychus texazona* McG. TM-4124 was more toxic than the other two at the 50 per cent. mortality level, but they were equally effective at higher levels. TM-4124 was more toxic than parathion, TM-4018 or TM-4049 to *Aphis gossypii* Glov. at the 50 per cent. level, but TM-4018 was the most toxic at higher levels. In the field, TM-4049 and TM-4124, applied in sprays at 0·4 and 0·3 lb. per acre, respectively, gave over 99 per cent. reduction of a heavy infestation by *A. gossypii* in two days. Neither TM-4049 nor TM-4124 was as toxic as toxaphene in dusts against *Heliothis armigera* (Hb.), TM-4124 was more effective than TM-4049, TM-4018 or toxaphene against *Anthonomus grandis* Boh., and a dust mixture containing 3 per cent. TM-4124 and 15 per cent. toxaphene was effective against both species.

VAN DEN BOSCH (R.), BESS (H. A.) & HARAMOTO (F. H.). **Status of Oriental Fruit Fly Parasites in Hawaii.**—*J. econ. Ent.* **44** no. 5 pp. 753–759, 6 graphs, 8 refs. Menasha, Wis., 1951.

Liberations of introduced insects against *Dacus ferrugineus dorsalis* Hend. were initiated in Hawaii in 1947 [*cf. R.A.E.*, A **39** 176]. By the end of 1950, 13 parasites and a Staphylinid predator had been released, and four of the parasites had become established and were parasitising the larvae severely on Oahu, Hawaii and Maui. These were *Opius longicaudatus* (Ashm.), *O. incisi* Silv., *O. oophilus* Fullaway, and a species of *Opius* that was at first thought to be *O. persulcatus* (Silv.) but is referred to as *Opius* sp. since its identity is doubtful. Females of *O. longicaudatus* deposit their eggs in larvae in the late second or third instar within the fruits, and those of *O. incisi* probably have similar habits, whereas eggs of *Opius* sp. are laid in the first-instar larvae, and those of *O. oophilus* in the eggs, the larvae developing in the host larvae.

Studies involving the regular collection of host fruits, largely wild guava, showed that the parasites spread rapidly. The adults apparently move quickly and in large numbers over considerable distances, and this has resulted in heavy parasitism of larvae in fruits that have short seasons and are scattered in distribution. The wide occurrence of wild guava, which fruits throughout the year, has provided an important reservoir for both host and parasites. Parasitism in guava had risen to 82·9 per cent. on Oahu by December 1950, and most of it was due to *O. oophilus*. *O. longicaudatus* had predominated in 1949, possibly owing to the large numbers liberated, but was overtaken by *Opius* sp. and the latter by *O. oophilus* in 1950. The last two species are favoured by their oviposition habits, and *O. oophilus* by the inability of the eggs of *Opius* sp. to develop in larvae already parasitised by it. There has been considerable reduction in the abundance of *D.f. dorsalis* on guava, and there seems no reason why this should not continue.

HILLS (O. A.) & TAYLOR (E. A.). **Parasitization of Dipterous Leaf Miners in Cantaloups and Lettuce in the Salt River Valley, Arizona.**—*J. econ. Ent.* **44** no. 5 pp. 759–762, 1 ref. Menasha, Wis., 1951.

Observations in the Salt River Valley of Arizona in 1938–47 showed that unidentified leaf-mining species of *Liriomyza* were of little importance as pests of vegetables, but a severe infestation on lettuce in the autumn of 1947 was followed by an outbreak on cantaloupe melons in June and July 1948 so severe that some fields had to be abandoned. Investigations on the parasites attacking the Agromyzids in the area and their effect on infestation were therefore begun. Samples of infested cantaloupe and lettuce leaves were collected weekly for various periods in 1948–50, and the hosts and parasites reared from them. The parasites obtained comprised the Miscogasterid, *Halticoptera aenea* (Wlk.), the Eulophids, *Derostenus arizonensis* Crwf., *D. variipes* Crwf., *Solenotus begini* (Ashm.), *S. websteri* (Crwf.), *Closterocerus utahensis* Crwf., *Diaulinopsis callichroma* Crwf., and *Chrysocharis parksi* Crwf., the Mymarid, *Anagrus giraulti* Crwf., the Trichogrammatid, *Trichogramma minutum* Riley, and the Braconids, *Opius dimidiatus* (Ashm.), *O. aridis* Gahan, *O. suturalis* Gahan and two unidentified species of the same genus. Of all the parasites reared, *H. aenea; D. arizonensis* and *S. begini* constituted 78 and 92 per cent. in cantaloupe and lettuce, respectively; and *H. aenea* was much the most numerous from both. In 1950, when all but *Anagrus* were recorded, the percentage parasitism ranged up to 62 in autumn lettuce, 44 in spring lettuce and 56 in cantaloupes. Notes on the life-histories of the parasites are given, so far as these are known. Lettuce and cantaloupe serve as food-plants for the leaf-miners throughout the year except in August and early September, the winter being passed on lettuce, which is little damaged, and the summer from April onwards on cantaloupes. Parasitism is very low in early autumn, but normally reaches a high level on lettuce in late winter and early spring. so that large numbers of parasites are available to attack the leaf-miners on cantaloupe in April. Conditions that interfere with the successful overwintering of the parasites may result in damage to the cantaloupe crop, and the results of small-plot experiments in 1950 indicated that repeated applications of DDT to cantaloupes were ineffective against *Liriomyza* but killed the parasites and resulted in an increase in the leaf-miner population.

DeBach (P.), Fleschner (C. A.) & Dietrick (E. J.). **A biological Check Method for evaluating the Effectiveness of entomophagous Insects.**— *J. econ. Ent.* **44** no. 5 pp. 763–766, 7 refs. Menasha, Wis., 1951.

Since the methods previously described for estimating the effectiveness of parasites and predators in controlling pests of *Citrus* in California [*cf. R.A.E.*, A **38** 253, etc.] have certain disadvantages, a new method is described. It is based on the use of ants that feed on honeydew to suppress the natural enemies [*cf.* **35** 127] and involves comparison of ant-free and ant-infested trees; the degree of accuracy depends on the intensity of ant activity. Recent studies have shown that *Iridomyrmex humilis* (Mayr) can be used to measure the effectiveness of natural enemies of *Aonidiella aurantii* (Mask.), *A. citrina* (Coq.) and *Paratetranychus citri* (McG.), and there seems no reason why the method should not be applied to other Diaspine scales and mites and to virtually all Homopterous honeydew-producing insects. *I. humilis* is the most abundant and widely distributed ant on *Citrus* in California, but *Formica cinerea neocinerea* Wheeler would be an excellent indicator in certain areas, and local species of ants could probably be used in many places. Adequate food must be available for them, and if necessary this should be provided by artificial colonisation of honeydew-producing insects or by smearing honey on the leaves.

In a lemon grove heavily infested by *A. aurantii*, scale populations were about seven times as great throughout the season on trees frequented by *I. humilis* as on trees free from ants and 150 times as great at the peak of seasonal scale increase, indicating the efficiency of the natural enemies of the scale. The percentage parasitism by *Aphytis* spp. was 35·3 in the presence of the ants and 49·7 in their absence, and though the total numbers of predators (*Lindorus lophanthae* (Blaisd.) and *Chilocorus* sp.) were reduced on the ant-infested trees, *L. lophanthae* was more abundant on them than on the ant-free trees, probably because the ants have less effect on it than on the other species and it consequently met with less competition and an increased food-supply.

The ants were feeding principally on honeydew secreted by *Pseudococcus citri* (Risso) and *Coccus hesperidum* L., and the numbers of colonies of these on ant-infested and ant-free trees were 52 and 2 for *P. citri* and 16 and 0 for *C. hesperidum.* In another lemon grove, ants interfered with predators of *Paratetranychus citri* to such an extent that at the peak of infestation, about ten times as many mites were present on ant-infested as on ant-free trees.

LINCOLN (C.). **Boll Weevil Infestations and Control in eastern Arkansas in 1950.**—*J. econ. Ent.* **44** no. 5 pp. 766–769, 1 ref. Menasha, Wis., 1951.

Records from several hundred cotton fields in the delta section of eastern Arkansas showed that infestation by the boll weevil [*Anthonomus grandis* Boh.] was extremely variable during the early summer of 1950. Early cotton was more heavily infested in June and July than late cotton, but infestation was heavy in August in all areas, even those in which early infestation had been light. In spite of heavier infestation by overwintered weevils and those of the first generation, control was easier to obtain in early than in late cotton because it required less prolonged protection from the second and later generations.

Insecticides applied early in the season did not reduce later infestations enough to affect the control measures required, and regular applications were necessary to keep heavy infestations in check late in the season. Where they were applied, control was excellent and migration was almost completely prevented. Nine applications of 20 per cent. toxaphene dust resulted in 1–14 per cent. punctured squares by 28th August, and nine of calcium arsenate alternated with a mixture of 3 per cent. γ BHC (benzene hexachloride), 5 per cent. DDT and 40 per cent. sulphur in 6–36 per cent., whereas 12 alternate applications to earlier cotton of calcium arsenate and the mixture resulted in 9–38 per cent. infestation, and 5–6 applications of calcium arsenate, the same mixture and another of 2·5 per cent. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], 5 per cent. DDT and 40 per cent. sulphur in 19–55 per cent. All dusts were applied at 10–15 lb. per acre, usually from aeroplanes. A spray containing 4 lb. toxaphene and 2 lb. DDT per U.S. gal., applied five times by ground machine, resulted in an average of 72 and a maximum of 95 per cent. punctured squares. Timing applications by the presence of feeding punctures and living weevils kept infestations at low levels without wasting insecticides.

MOORE III (S.) & SWEETMAN (H. L.). **Control and Eradication of Pest Thysanurans.**—*J. econ. Ent.* **44** no. 5 pp. 770–772, 4 refs. Menasha, Wis., 1951.

Four species of Thysanura, *Lepisma saccharina* L., *Ctenolepisma quadriseriata* (Pack.), *C. urbana* Slabaugh and *Thermobia domestica* (Pack.), are pests in buildings in the United States [*cf. R.A.E.*, A **33** 106–107] and are difficult to eradicate, though repeated applications of pyrethrum, DDT, chlordan or lindane [at least 99 per cent. γ benzene hexachloride] in sprays or dusts over long periods reduce heavy populations.

In tests in Massachusetts, automatic and continuous vaporisation of minute quantities of lindane showed promise for eradication of *T. domestica.* The treatment destroyed the insects with no apparent hazard or inconvenience to occupants of buildings, was practically odourless and did not stain. Tests with comparable amounts of lindane as vapour or as sprays applied to baseboards, pipes, heating units and other places in which the insects congregate, in buildings of similar arrangement and size, showed that the reappearance of the insects was delayed for about twice as long after the application of 2·69–3·5 gm.

lindane vapour per 20,000 cu. ft. per day for 14 days as after spraying with similar quantities of lindane, probably owing to more complete elimination due to penetration of the vapour into harbourages of the pests rather than to residual deposit. Comparable numbers of dead insects were recovered from the two treatments. When combined treatment with a DDT spray and dust was compared with lindane, applied as vapour at 0·81 gm. per 20,000 cu. ft. per day, the vapour was the more effective. DDT prevented the reappearance of *T. domestica* for 95 days, whereas lindane was still preventing it after 178 days.

In laboratory tests in which males, females and nymphs of *T. domestica* were caged with food at distances of 10, 20, or 30 ft. from the source of lindane vapour, complete mortality was given in 4–5 days by doses of 1·52–1·69 gm. per 20,000 cu. ft. per day and the distance from the source of vapour did not influence the rapidity of mortality, indicating that lower rates would also be effective. Eggs laid during exposure hatched normally.

It is concluded that the continuous evolution of minute quantities of lindane vapour over an extended period should gradually eradicate Thysanura from buildings. Lindane appeared to be repellent to *T. domestica*, which became more active immediately after treatment ; this reaction was not observed with DDT. Toxicity tests with fish, birds and mammals suggested that the method is relatively safe for use.

ZIA-UD-DIN. **Tests of Lindane and other Insecticides for Control of** ***Lygus oblineatus*****.**—*J. econ. Ent.* **44** no. 5 pp. 773–779, 1 graph, 11 refs. Menasha, Wis., 1951.

Insecticides were tested for the control of *Lygus oblineatus* (Say) in Michigan in 1948–50. In greenhouse tests, Chinese cabbage plants were sprayed with 14 insecticides, allowed to dry and infested with the bug. The insecticides were applied at low, medium and high concentrations, which were in the ratio of 1 : 2 : 4, and the lowest, in oz. per 100 U.S. gals., is shown in brackets after each. Nicotine sulphate (8), a mixture of nicotine sulphate, pyrethrum and sulphur (6, 1·44, 24), rotenone (1·6), *Ryania* (48), Pestox 3 [a proprietary preparation of schradan (bisdimethylaminophosphonous anhydride)] (5·28) and allethrin [synthetic allyl homologue of cinerin I] (0·32) gave little control as estimated by Abbott's formula [*R.A.E.*, A **13** 331] at the highest concentration and methoxy-DDT (methoxychlor) (8) gave none. *Ryania* and rotenone showed delayed action. DDT (8) and DDD (TDE) [dichlorodiphenyldichloroethane] (8) gave over 80 per cent. control in 96 hours at the two higher and the highest concentrations, respectively, and toxaphene (6·4) 70 per cent. at the two higher ; toxaphene was slow in action. Chlordan (6·4) and parathion (1·2) gave complete control within 72 hours at the two higher concentrations, and lindane [at least 99 per cent. γ benzene hexachloride] (2) within 48 hours at all three. Lindane combined immediate kill with prolonged effectiveness (12 days in August and 16 days in May for the medium concentration and one month for the highest in May). TEPP [tetraethyl pyrophosphate] (4) gave complete immediate control at the highest concentration but was ineffective three hours later. It would be the best insecticide for controlling heavy infestations of *Lygus* immediately before harvest. Supplementary tests on the residual effect of insecticides at medium concentration, in which fresh batches of bugs were released every 24 hours, showed that lindane was effective for 12 days, chlordan and DDT for 6 days, DDD and parathion for 5 and 4 days, respectively, and TEPP for 2–3 hours.

In field-plot tests, Chinese cabbage was planted on 1st July 1950, sprayed with 25 per cent. lindane at 24·6 oz. per acre, 15 per cent. parathion at 36·9 oz., 50 per cent. TEPP at 24·6 oz. or a mixture of nicotine sulphate, 18 per cent. pyrethrum and 95 per cent. sulphur (18·5, 24·6 and 73·8 oz.) on 16th and 26th

July and 5th August, and examined for *Lygus* infestation on 6th August. All treatments gave significant control, and lindane was significantly better than the other three. In a test in field-cages 600 sq. ft. in area with lindane applied 2, 4 or 6 times at the original low, medium and high concentrations, celery was transplanted in the cages on 10th June 1950 and 200, 400 or 800 bugs were introduced in batches on dates corresponding to the observed peaks of infestation in the field. Sprays were applied on 29th June and 7th August ; 29th June, 18th July and 7th and 27th August ; or 29th June, 12th and 26th July, 9th and 23rd August and 7th September, and statistical analysis showed that the yield did not vary significantly as a result of differences in infestation or insecticide concentration, but that it increased by 1·7, 5·3 and 2·2 tons per acre after 2, 4 and 6 applications, respectively, the first and third increases being non-significant and the second highly significant. Analysis of the percentages of injured stalks and of the total numbers of feeding punctures showed that both tended to increase significantly as infestation increased and decreased significantly as concentration and number of applications increased, though in some cases the medium concentration was as effective as the high one and four applications as effective as six. All analyses indicated that unless the infestation is extremely high, four applications at medium concentration give the most satisfactory control when yield and quality are considered. If infestation is very high, six applications will give celery of high quality, but reduce the yield. No changes in flavour were detected.

LANCHESTER (H. P.). **A modified Probit Method for Comparison of Insecticides for Wireworm Control.**—*J. econ. Ent.* **44** no. 5 pp. 779–784, 2 graphs, 7 refs. Menasha, Wis., 1951.

The following is substantially the author's summary. Comparison of the toxicity of insecticides to wireworms (*Limonius* spp.) necessitates the determination of mortalities in relation to time and concentration. The common practice of making a single comparison at some specific mortality level is of little value, owing to the inherent differences in the various insecticides. A modified form of probit analysis, in which the probit of mortality is plotted against the logarithm of the product of exposure time and concentration, is used to produce a single straight line. This line provides both a visual measure of the efficiency of the insecticide against *Limonius* for comparison with others and a ready and accurate estimate of the dosage to be tested in the field. The accuracy of the experiment and the range of the estimates may be determined, but most laboratory tests are intended to give rough approximations, and the eye-fitted regression line may prove to be sufficient without further calculations.

GYRISCO (G. G.) & MARSHALL (D. S.). **Further Studies of the Control of Insects of Red Clover in New York.**—*J. econ. Ent.* **44** no. 5 pp. 785–791, 1 ref. Menasha, Wis., 1951.

Tests of dusts for the control of insects attacking red clover in New York [*cf. R.A.E.*, A **39** 108] were continued in 1949, when effectiveness against 15 species was considered. BHC (benzene hexachloride) was applied at about 0·5 lb. γ isomer per acre and the other materials at about 1 lb. toxicant per acre. The results showed that dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], heptachlor[1(or3a),4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] and parathion were the most effective for the control of the whole insect complex. Dieldrin and chlordan had the most prolonged effect, whereas aldrin and parathion lost toxicity within a week. BHC showed promise, but toxaphene, though highly toxic to some species, was not very effective against the total population.

Dieldrin, aldrin, heptachlor, chlordan and BHC were all effective against *Melanoplus femur-rubrum* (Deg.) and other grasshoppers ; dieldrin and BHC gave 95 and 84 per cent. control, respectively, for three weeks and chlordan 85 per cent. for two weeks, and aldrin and heptachlor persisted for a somewhat shorter time than dieldrin. Parathion and dieldrin gave 98 per cent. control of *Sitona flavescens* (Marsh.) for a week and were the best insecticides tested against it. All materials gave promising control of *Tychius* spp. and *Lygus oblineatus* (Say), dieldrin, parathion, aldrin and chlordan, in that order, being the best against *Tychius*, and BHC, dieldrin, parathion, toxaphene and chlordan against *Lygus*. Other insects did not occur in sufficient numbers to permit definite conclusions.

WILSON (M. C.). **Control of the Sweetclover Weevil in Indiana.**—*J. econ. Ent.* **44** no. 5 pp. 792–796. Menasha, Wis., 1951.

In Indiana, overwintered adults of *Sitona cylindricollis* Fhs. appear in March and feed on the foliage of second-year sweet clover [*Melilotus*] until new seedlings appear, when they attack and destroy many of these. The eggs are laid in the soil and the young larvae feed on the rootlets of the sweet clover, but the plants survive this attack and that of the newly emerged adults in August. Control measures are therefore directed against the adults in early spring.

In 1948, dusts were applied with a hand duster to small plots of second-year sweet clover before the new seedlings appeared, and dead weevils were counted 48 hours later. The numbers of these per sq. ft. were significantly higher for parathion at 1 and 0·5 lb. per acre and toxaphene at 2·5 lb. than for 2·5 lb. DDT, methoxy-DDT (methoxychlor) or chlordan, which did not give significant mortality ; that for BHC (benzene hexachloride) at 0·5 lb. toxicant per acre was just significant. It is possible that DDT killed slowly and gave the weevils time to move into crevices to die, as subsequent experiments all showed it to be highly effective, with a long persistent effect. Applications to heavily infested sweet clover (planted in oats) of 5 per cent. DDT or toxaphene at 40 lb. per acre from an aeroplane on 25th May gave adequate control, as the surviving plants recovered, with no apparent difference between the two materials, although greater numbers of dead weevils were found on the area treated with toxaphene. When applied to second-year sweet clover, sprays of DDT and toxaphene in emulsions at 1·5 lb. toxicant per acre, lindane [at least 99 per cent. γBHC] in emulsion at 0·25 lb. and wettable parathion and ethyl p-nitrophenyl thionobenzenephosphonate at 1 lb. all gave significant control as estimated from leaf injury two weeks after treatment, and DDT was significantly better than lindane but not than the other materials.

In 1949, 2·5 lb. DDT, 5·5 lb. methoxy-DDT, 3 lb. toxaphene, 0·75 lb. BHC (0·5 per cent. γ isomer), 1·2 lb. parathion, 1·5 lb. aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] or 0·5 lb. dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] per acre in an inert carrier was applied to the soil of plots sown with oats and sweet clover as soon as the latter had germinated. Examination after the oats were harvested showed the best stands of sweet clover in plots treated with DDT and dieldrin, both of which had very persistent effects and were significantly better than no treatment. In 1950, 0·5 or 1·5 lb. DDT in 400 lb. superphosphate or rock phosphate as carrier per acre was applied to germinating sweet clover that had been sown with oats. Examination three weeks later showed that 1·5 lb. DDT caused a highly significant decrease in weevil injury, a highly significant increase in the number of plants per sq. ft. and a non-significant increase in the vigour of the plants, whereas 0·5 lb. DDT was ineffective. All plots treated with superphosphate showed greater vigour, more plants per sq. ft. and less visible weevil injury than corresponding treatments with rock phosphate. These treatments were more effective than spraying with 2 lb. DDT in 15 U.S. gals. water per acre when the clover was in the two-leaf stage.

PAINTER (R. H.) & WEIBEL (D. E.). **European Corn Borer Damage to Grain Sorghums.**—*J. econ. Ent.* **44** no. 5 pp. 796–798, 3 figs., 9 refs. Menasha, Wis., 1951.

Pyrausta nubilalis (Hb.) has been recorded from sorghums in the United States and elsewhere on several occasions, though there is evidence that some varieties are resistant to it. It spread to the eastern edge of the sorghum-growing area of the United States in 1949 and 1950 and infested sorghum there in both years. Larvae of the second generation were found in a sorghum variety nursery at Manhattan, Kansas, in 1950; in one row, 5 of 79 stalks examined were infested. The sorghum had been planted on 5th-7th June, and the damage was evident by the middle of September, when the heads of infested stalks began to break over. The injury was similar in many respects to that in maize, but the burrows occupied relatively more of the diameter of the stalk, appeared to be shorter and were often partly filled with liquid from the plant. About a third of the larvae seen in mid-September were in webs among the young kernels in the heads. The south-western corn borer, *Diatraea grandiosella* Dyar, attacks sorghum only if it is near maize plants, and neither species has been found on sorghum in Kansas in the first generation, indicating that infestation by *P. nubilalis* is most likely to occur on sorghum in the neighbourhood of maize. Larvae of *D. grandiosella* that matured on sorghum were only about two-thirds as heavy as those on maize, but *P. nubilalis* appeared to thrive as well on some sorghums as on maize, or even better, at least after the larvae had become established.

The infestation in the nursery was too light to be of much significance for a study of varietal resistance, but it was confined mostly to varieties of a combine type that had milo in their parentage. The more heavily infested strains were earlier in heading than many of the uninfested ones, and infestation was difficult to find in stalks of the taller and later varieties, many of which were forage sorghums, though infestation was reported in fields of forage sorghums in two localities in Kansas in 1949.

FLITTERS (N. E.). **Vanda " Miss Agnes Joaquim " a Host of** *Dacus dorsalis*.—*J. econ. Ent.* **44** no. 5 pp. 799–802, 2 figs. Menasha, Wis., 1951.

As a result of the discovery of small infestations by *Dacus ferrugineus dorsalis* Hend. of field-grown buds and flowers of *Vanda* orchids of the variety Miss Agnes Joaquim in Hawaii, and of apparently viable eggs on the lips of the open flowers, the shipment of *Vanda* blooms to the mainland of the United States was temporarily suspended on 23rd March 1949. The investigations described in this paper, however, indicated that such shipment involves no practical risk of transporting the insects, and the flowers were therefore freed from quarantine restrictions, other than inspection, in April 1950 [*cf. R.A.E.*, A **39** 176]. Examination of more than 27,000 flowers showed infestations in only 80, and these consisted chiefly of desiccated eggs, and attempts to rear the fruit-fly from 23 field-infested buds resulted in the survival of five larvae and the emergence of one male in the decayed remains of a bud, indicating that extremely suitable conditions had to be provided if *D. f. dorsalis* was to be reared from infested buds.

When buds were artificially infested with eggs and kept in outdoor cages, the eggs hatched in 24–72 hours, but no activity was observed after the second day of larval life, indicating that the flowers are not suitable for normal larval development and apparently not attractive as food to the young larvae. When artificially infested flowers were packed in standard commercial shipping boxes, sealed and kept at optimum rearing conditions at 25°C. [77°F.] and 70 per cent. relative humidity, only 26 larvae were obtained from 1,250 eggs and these all died in the first instar. Larvae from eggs inserted in the fleshy column of the flower did not enter the tissue and were dead and desiccated after seven days. When four freshly-picked buds were exposed to gravid females for 48 hours, 65 eggs were found on them and 32 larvae hatched, but none survived for more than 36 hours. The buds had not decayed and did not provide succulent food. When 24 buds were exposed to gravid flies for 24 hours and then packed in standard shipping boxes, sealed and stored at a temperature of 27°C. [80·6°F.] and 80 per cent. relative humidity, the buds were decayed in nine days, and examination revealed 14 larvae, of which eight were alive. One survived to pupate and gave rise to a deformed undersized male.

These results and the fact that blooms showing discoloration are discarded at the packing houses showed that the possibility of transporting *D. f. dorsalis* in infested *Vanda* flowers is remote.

BOTTGER (G. T.). **Comparative Toxicity of Allethrin and natural Pyrethrins.**—*J. econ. Ent.* **44** no. 5 p. 808. Menasha, Wis., 1951.

The toxicity of allethrin [the synthetic allyl homologue of cinerin I] to third-instar larvae of *Leucania* (*Cirphis*) *unipuncta* (Haw.), fourth-instar nymphs of *Oncopeltus fasciatus* (Dall.) and adults of *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)) was compared with that of natural pyrethrums by applying them at various concentrations in dusts, dips or sprays and calculating the median lethal deposits of the dusts or concentrations of the liquids on the basis of mortality after about 48 hours. The dusts were made by diluting allethrin or powdered pyrethrum flowers containing 0·47 per cent. pyrethrin I and 0·46 per cent. pyrethrin II with pyrophyllite and the sprays or dips by forming emulsions of allethrin or pyrethrum extract containing 8·05 and 8·48 per cent. pyrethrins I and II with acetone and diluting with water.

The larvae of *L. unipuncta* were treated by feeding them on pieces of barley leaves that had been dusted or sprayed and allowed to dry, the Aphids by dusting or dipping infested bean leaves and then putting them on uninfested bean plants, and the *Oncopeltus* nymphs by spraying them until the dorsal surface was wet. The results showed that the pyrethrins were about 2·8 times as toxic as allethrin in the dusts and 10·9 times as toxic in the sprays to the larvae of *Leucania*, and 14·2 times as toxic in the dusts and 3·8 times as toxic in the dips to the Aphid, but allethrin was 2·5 times as toxic as the pyrethrins to *Oncopeltus*.

SHERMAN III (F.). **Parathion to kill Fruit Fly Maggots in Cherries.**—*J. econ. Ent.* **44** no. 5 p. 809. Menasha, Wis., 1951.

Cherries are a very valuable crop in Michigan, and the State Department of Agriculture maintains an inspection service to ascertain the extent of infestation by cherry fruit-flies (*Rhagoletis*) in the orchards. Infested crops must be picked as soon as possible and either buried two feet below the surface of the ground with a covering of quicklime or burnt. This procedure, in addition to the crop loss, is very costly. An important source of infestation is the wild pin cherry (*Prunus pennsylvanica*), which occurs throughout the cherry-growing areas of the state and is commonly heavily infested with *Rhagoletis*.

In 1949, aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,-4a,5,6,7,8,8a-octahydro-1,4,5,8-diendomethanonaphthalene] and parathion were tested for the control of the larvae in heavily infested pin cherries. The trees and the soil beneath them were thoroughly sprayed on 2nd August and samples of fruit picked on 9th August. The numbers of larvae that emerged from 2 U.S. quarts fruit were 115 and 228 for sprays of 16 and 8 oz. aldrin per 100 U.S. gals. water, 38 and 77 for 16 and 8 oz. dieldrin, 0 and 7 for 32 and 16 oz. 15 per cent. parathion and 250 for no treatment. Parathion was further tested on wild pin cherries and Montmorency cherries in 1950, when sprays were applied on 8th August and fruit samples taken on 15th August. The numbers of larvae per 2 U.S. gals. of wild cherries were 1, 0 and 0 for 16, 32 and 48 oz. 15 per cent. parathion per 100 U.S. gals. water, respectively, and 25–61 for no treatment. None emerged from 15 lb. Montmorency cherries sprayed with 16, 32 or 48 oz. 15 per cent. parathion and 535–1,065 from 15 lb. untreated ones.

FLANDERS (S. E.). *Prospaltella* **as a secondary Parasite of Mealybugs.**—*J. econ. Ent.* **44** no. 5 p. 810, 1 ref. Menasha, Wis., 1951.

The author records that five males of *Prospaltella* were reared from parasitised examples of *Pseudococcus nipae* (Mask.) sent to California from Jamaica. Since it is usual in the genus *Prospaltella* for the female to be a primary parasite and the male a secondary parasite of Aleurodids and Diaspine Coccids, they probably developed hyperparasitically on the primary parasites inhabiting the mealybugs.

Specimens of *Prospaltella* reared from eggs of the codling moth [*Cydia pomonella* (L.)] on walnut in California in 1924 [*cf. R.A.E.*, A **12** 585] were also males and probably hyperparasitic on the early developmental stages of *Trichogramma*; about 3 per cent. of 1,297 *Cydia* eggs were parasitised, and 92 per cent. of these yielded *Prospaltella* instead of *Trichogramma*.

STONE (P. C.) & SMITH (G. E.). **Preliminary Insecticide-Fertilizer Soil Treatments.**—*J. econ. Ent.* **44** no. 5 pp. 810–811. Menasha, Wis., 1951.

In Missouri, considerable areas of maize sown on *Lespedeza* sod that has been turned under require resowing each year owing to damage by the grape colaspis [*Colaspis flavida* (Say)]. The planting of a test plot of field maize to study the effect of soil treatment with insecticides and a fertiliser in controlling the insect were delayed until too late for damage by it, but the effect of the treatments on the maize was investigated. The insecticides were chlordan, aldrin [1,2,3,4,10,10 - hexachloro - 1,4,4a,5,8,8a - hexahydro - 1,4,5,8 - diendomethanonaphthalene], dieldrin [1,2,3,4,10,10-hexachloro-6,7-epoxy-1,4,4a,5,6,7,-8,8a-octahydro-1,4,5,8-diendomethanonaphthalene], heptachlor [1 (or 3a),4,5,-6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-4,7-endomethanoindene] and lindane [at least 99 per cent. γ benzene hexachloride], and each was applied at 1 lb. per acre mixed with a 3 : 12 : 12 fertiliser, which was used with or without them at 200 lb. per acre. The mixtures were applied to the rows and covered with soil before the seeds were sown, and all maize was given the usual side dressing of 66 lb. nitrogen per acre.

During the first month, the maize treated with fertiliser alone or mixed with lindane was taller than untreated maize, and that treated with fertiliser and the other insecticides taller still, but by August all plants but those in untreated rows were equally tall. The maize was harvested in early November, and the yields from the treated rows did not differ significantly from one another but were about 50 per cent. higher than the yields from those receiving no treatment. Factors that may have accounted for the increased size and uniformity of the insecticide-treated maize seedlings are the death of the usual root-feeding and root-pruning insects ; the reduced inoculation of the maize roots with harmful soil micro-organisms on the death of the root-feeding insects ; the decrease or increase of soil micro-organisms due to the presence of the insecticide ; a hormone effect of the insecticide that increased the number and size of maize leaves and roots ; and the availability of additional plant nutrients brought about by a reaction of the insecticide with the soil.

More information is required before insecticides can be safely used in field-crop rotations, as different plants react differently to the insecticides and some of these remain active in certain types of soil for several years.

WALLIS (R. L.). **Potato Psyllid Selection of Host Plants.**—*J. econ. Ent.* **44** no. 5 pp. 815–817, 3 refs. Menasha, Wis., 1951.

Tests were carried out in 1941–45 to determine the preferences of ovipositing adults of *Paratrioza cockerelli* (Šulc) among the common wild and cultivated solanaceous plants of Colorado, Wyoming and Nebraska. The plants, which included tomato and potato, were grown in small plots at one locality in Nebraska, and leaf samples of an area approximately equal to 50 potato or tomato leaflets were taken at weekly intervals, from about 15th July until the plants were killed by frost, and examined for eggs. Statistical analysis showed that significantly more eggs were laid on *Physalis francheti* and *Solanum carolinense* than on cultivated and wild groundcherry (*P. ixocarpa* and *P. lanceolata*), and more on these than on any other plants. *P. francheti* and *P. ixocarpa* are annuals cultivated to only a limited extent and therefore of little importance as sources of Psyllids that may migrate to potato and tomato, but *S. carolinense* and *P. lanceolata* are widespread wild perennials and therefore important.

Some plants were tested for 1–3 years only, because of the difficulty of propagating them, and of these, *P. pruinosa, Nicandra physaloides* and *Nierembergia hippomanica,* which are grown to a limited extent, and *Datura stramonium,* a wild plant that does not grow abundantly in the area, were preferred to many of the more commonly occurring plants.

REID jr. (W. J.). **Zinc Ethylene Bisdithiocarbamate toxic to Pickleworm and Melonworm.**—*J. econ. Ent.* **44** no. 5 pp. 817–818, 1 ref. Menasha, Wis., 1951.

Zineb (zinc ethylene bisdithiocarbamate) was found by W. G. Genung in 1949 to give considerable reductions in populations of *Diaphania hyalinata* (L.) and *D. nitidalis* (Stoll) when applied as a fungicide to late cucumbers in Florida. In similar observations by the author in South Carolina in 1950, zineb applied weekly as a fungicide in a 4 per cent. dust at 25–30 lb. per acre or in a spray containing 2 lb. 65 per cent. wettable powder per 100 U.S. gals. at the rate of 50–75 U.S. gals. per acre gave some control of *D. nitidalis*, and it was therefore tested for insecticidal effect in laboratory cages and in small field plots in a late planting of squash.

In the laboratory, two brands of zineb were applied to larvae of *D. nitidalis* in 3·9 per cent. dusts at average and heavy rates of application (about 20 and 40 lb. per acre). One gave 50 and 60 per cent. mortality, respectively, of fourth-instar larvae and the other 35 and 50 per cent., but no fifth-instar larvae were killed by heavy rates of either. In the field, the two brands were compared with lindane [at least 99 per cent. γ benzene hexachloride] in four spray applications of approximately 80 U.S. gals. per acre at intervals of 5–7 days between 2nd and 20th November. Both brands at 2 lb. per 100 U.S. gals. reduced the population of *D. nitidalis* gradually, with no significant difference between them, but lindane at 1 lb. 25 per cent. wettable powder per 100 U.S. gals. was much superior, giving complete control of the larvae in the flowers after the second application. Lindane reduced the numbers of infested fruits by about 63 per cent., whereas zineb had no apparent effect on fruit infestation ; many materials that are only partly effective against *D. nitidalis* do not kill enough larvae to protect the fruits. Only a few larvae of *D. hyalinata*, which usually feed on the leaves, were present in the field plots, and the zineb sprays were less toxic to them than lindane, though they slightly reduced the numbers in the flowers.

SUMMERLAND (S. A.) & HAMILTON (D. W.). *Hemisarcoptes malus*, **a Predator of Forbes Scale.**—*J. econ. Ent.* **44** no. 5 p. 818, 6 refs. Menasha, Wis., 1951.

Examination of numerous adults of *Quadraspidiotus* (*Aspidiotus*) *forbesi* (Johnson), collected in an unsprayed orchard near Vincennes, Indiana, during June 1950, showed that 2–3 mites, identified as *Hemisarcoptes malus* (Shimer) were present under the scale of each. There were dark spots, where the mites had apparently probed, on the adults, many of which were dead and drying up. As crawlers and adults were difficult to find and the mites plentiful in the orchard, it appears that this predator was contributing extensively to the control of the Coccid.

WYLIE (W. D.). **Technique in jarring for Plum Curculio.**—*J. econ. Ent.* **44** no. 5 pp. 818–819. Menasha, Wis., 1951.

The author describes the equipment and technique successfully used for jarring peach trees to obtain adults of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] in Arkansas in 1949–50. A sheet 4 ft. by 7 ft. in size, attached to a light hinged wooden frame, is held under the branches of successive trees, these are tapped sharply with a rubber-covered mallet once or twice, and the weevils are collected at the end of the jarring period (or immediately if they are active owing to high temperatures) in a small bottle fitted with a slit rubber top. No attempt is made to jar an entire tree, and the unit of measurement of abundance is based on the amount of time spent jarring, which is usually five minutes. In summer, the temperature is too high for satisfactory jarring during most of the day, and more records can be made while conditions are favourable if individual limbs are jarred. The sheet can be held close under the branches during jarring, and fewer weevils fly before hitting it than before hitting a sheet on the ground. They can be removed more easily from a small sheet on a rigid frame than from a large sheet spread on the ground. The method has the advantages that only one person is needed to take the records, that more can be taken in a given time than by other methods and that difficulties due to variations in tree size, unevenness of terrain and high temperature are decreased or eliminated.

METCALF (C. L.) & FLINT (W. P.). **Destructive and Useful Insects. Their Habits and Control.**—3rd edn. revd. by R. L. Metcalf, 9¼×6¼ ins., xiv+1071 pp., 584 figs., many refs. New York & London, McGraw-Hill Book Co., Inc., 1951. Price 85s.

This third edition of a text-book of economic entomology in the United States and southern Canada resembles the previous ones [*R.A.E.*, A **17** 29 ; **27** 655] in general arrangement, but, in order to bring it up to date, some sections, notably those dealing with insecticides and other materials used in chemical control and with equipment for the application of insecticides, have been extended and partly rewritten. The structural formulae of over 150 substances and information on their chemical, physical and insecticidal properties are given. The recommendations for the control of specific pests contained in the latter part of the book have been modified accordingly, and a number of additional Arthropods that have recently become injurious are included.

HÅRDH. (H. J. E.). *Amblymerus graminum* **n. sp. (Hym., Chalcididae), a Pteromalid living in the Wheat Stem.**—*Ann. ent. fenn.* **16** no. 2 pp. 84–88, 4 figs., 6 refs. Helsinki, 1950.

Spring wheat grown in western Finland sometimes shows symptoms similar to those caused by foot-rot fungi (poor development, wrinkling and premature ripening of the kernels) in the absence of infection by the causal agents. When the stalks of such wheat were examined microscopically in September 1949, larvae of a Pteromalid described from adults of both sexes as *Amblymerus graminum*, sp. n., were found in many of them, mostly in the lowest or second lowest internode. No gall formations were observed, and there was no evidence that they were parasitic. There was normally one larva per stem, but occasionally two in different internodes. The larvae, which are briefly described, were reared in the laboratory, and the pupal stage lasted 7–13 days at 21–26°C. [69·8–78·8°F.]. They presumably suck the sap from the wall, apparently overwinter in the stubble or straw and pupate in spring. The adults emerge through a hole cut in the stalk. There is probably more than one generation a year.

[USHATINSKAYA (R. S.).] **Ушатинская (Р. С.). The Course of certain Processes in the Body of Insects at low Temperature.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **68** no. 6 pp. 1101–1104, 1 graph, 13 refs. Moscow, 1949.

In the experiments described, diapausing larvae of *Cydia* (*Laspeyresia*) *pomonella* (L.) and adults of *Bruchus pisorum* (L.) collected in the field in Russia were kept for increasing periods at various almost constant temperatures between 11 and −11°C. [51·8 and 8·2°F.] and 5 [41°F.] and −11°C., respectively, and almost 100 per cent. relative humidity. It was found at all temperatures that the body weight decreased with increasing duration of exposure. At temperatures above freezing-point, this was accompanied by successive falls in the content of fat and increases in that of water, and at temperatures below freezing-point by successive decreases in water content, the fat content not varying significantly. These results were confirmed by field observations on larvae of *C. pomonella* hibernating under trap-bands on apple trees in central Russia in the winter of 1947–48, and the larvae were further found to pass through a period of preparation for hibernation that was characterised by a fall in body-weight, considerable loss of water and some loss of fat.

The variations in the changes during hibernation are due to differences in metabolism. This proceeds fairly intensively at temperatures above freezing-point at the expense of fat and leads to the production of more water than can be eliminated at the prevailing high relative humidity, but at temperatures below freezing point, metabolism is reduced to a minimum and the little water produced is not sufficient to compensate for the natural loss, so that dehydration results. The loss of fat in the pre-hibernation period is probably due to its conversion into some substance (such as glycogen or albumin) that is easily assimilated at low temperatures. When temperatures rise in spring, activity is not resumed until metabolism increases and any water deficiency is made up. The bearing of these observations on insects hibernating at temperatures above and below freezing-point is briefly discussed. Below freezing-point, excessive dehydration is a common cause of death.

[TZITOVICH (I. K.) & SNITKO (Yu. S.).] **Цитович (И. К.) и Снитко (Ю. С.). The Susceptibility of Phases of one Generation of** *Eurygaster integriceps* **Put. to Dichlorodiphenyltrichloroethane.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N. S.) **70** no. 1 pp. 153–155, 2 graphs, 4 refs. Moscow, 1950.

In tests in the Soviet Union, freshly deposited eggs, nymphs in each instar and overwintered and newly emerged adults of *Eurygaster integriceps* Put.

were placed in jars of 1,000 ml. capacity, 0·4 gm. of a dust of 5·5 per cent. DDT on talc was then blown into each and fresh grain plants were introduced. There was no effect on the eggs, which hatched normally. The resistance of the nymphs increased with the instar, the mortality percentages falling from 100 in 24 hours for the first two instars to less than 60 in 4 days for the fifth. Mortality of the adults in 8 days was nearly 100 per cent. for overwintered individuals, but less than 5 per cent. for newly emerged bugs with hardened integuments, though those treated before the integument had hardened showed 50 per cent. mortality in 3 days (about the same as overwintered adults).

The increasing resistance of the nymphs is probably related to the progressive thickening of the chitinous integument and development of the fat tissues, which constitute a barrier to the penetration of the insecticide [*cf.* *R.A.E.*, A **37** 43–44], but the greater resistance of the newly emerged adults once the integument had hardened as compared with overwintered individuals cannot be due to this and may be related to some condition of the organism connected with the onset of reproduction.

Boyce (S. W.) & others. **Preliminary Note on Yellow-leaf Disease of** *Phormium.*—*N.Z. J. Sci. Tech.* **33** (A) no. 3 pp. 76–77. Wellington, N.Z., 1951.

Phormium in New Zealand has long been attacked by yellow-leaf disease, which has been partly responsible for the destruction of the plant over large areas in the North Island, threatens production over half the remaining area there and has hampered attempts to improve the crop by selection, breeding and improved cultural methods. The symptoms comprise yellowing and wilting of the leaves, stunted growth, premature flowering, rotting and death of the rhizomes and roots, and invasion by secondary organisms, and culminate in the death of the plant after periods varying from a few months to several years. The disease is commoner in the North than in the South Island, and in natural stands of *P. tenax* than in those of *P. colensoi*.

Failure to find a fungous, bacterial or physiological cause indicated that the disease was possibly due to a virus, and this was subsequently confirmed. Successful root grafts between diseased and healthy mature plants of *P. tenax* were obtained in September 1947, and three healthy plants showed symptoms by March 1950. During 1949–50, a high rate of transmission was obtained by carborundum abrasion among seedlings of *P. tenax* 18 months old, which developed symptoms after 4–16 months. Experiments on insect transmission were begun in December 1949, when adults of *Oliarus atkinsoni* Myers, a native Cixiid present in large numbers in one area, were collected from diseased plants and placed on 20 healthy seedlings of *P. tenax* 7–8 months old. Excessive leaf yellowing appeared in 4–7 weeks, and by 24th April 1951, 16 plants showed typical internal symptoms. These results were confirmed by further experiments, some on a large scale, in one of which Cixiids from an area that appeared to be free from the disease were used as controls ; this showed that the symptoms are unlikely to be due to a toxin of insect origin. Tests with thrips, mealybugs and Aphids gave negative results, and no other plant hosts of the virus were discovered, but some evidence of seed transmission was obtained. Nymphs of *O. atkinsoni* infest the roots and leaf bases from March to November, and outbreaks have long been observed to follow extensive draining and the prevention of flooding. This is attributed to the inability of the nymphs to survive immersion for a few days, although the plants can withstand flooding to a depth of 2–3 ft. for up to four weeks in winter. Regulated flooding may provide a means of control in some areas.

Bryan jr. (E. H.). **Economic Insects of Micronesia. Report of the Insect Control Committee for Micronesia 1947–1948.**—[2+] 29 pp., 5 figs., 1 map, refs. Washington, D.C., Nat. Res. Coun., 1949.

The Insect Control Committee for Micronesia was set up in 1947 to carry out investigations in connection with the control of insect and other pests of crops in Guam and the U.S. Trust Territory of the Pacific (the Caroline and Marshall Islands and the Mariana Islands excluding Guam), and this report comprises an account of its organisation, lists of the insects of economic importance in the area and of insect parasites and predators introduced at any time into it, and a summary of the work accomplished up to April 1949. Considerations that led to the establishment of plant and animal quarantines and the main provisions of these are briefly outlined. The most important insect pests of crops in the area are *Oryctes rhinoceros* (L.), *Brontispa mariana* Spaeth and *Furcaspis oceanica* Ldgr., all on coconut, and *Dacus ferrugineus dorsalis* Hend., which attacks numerous fruits, and notes are given on their bionomics, distribution, economic importance and natural enemies.

O. rhinoceros occurs in the Palau or western Caroline Islands, where it appears to have been first seen in 1942, and the adults bore through the leaf sheaths and immature leaves and stalks in the crowns of the palms. *Scolia patricialis* Burm. var. *plebeja* Grib. was found to parasitise the larvae in Malaya and was introduced into Palau and liberated early in 1948, and *S. ruficornis* F. was collected in Zanzibar and also liberated against *Oryctes*. Neither is yet known to have become established. *B. mariana* was very injurious on Saipan (Marianas) in 1935–36. It was first observed there in 1931 and may have spread from the Carolines, where it is widely distributed, though it is replaced by a related species in Palau [*cf.* *R.A.E.*, A **39** 442]. Coconut is its main food-plant, but the leaves of *Areca catechu* and another palm (? *Eupritchardia*) were attacked, though not readily, in the laboratory. *Haeckeliania brontispae* Ferrière and *Tetrastichus brontispae* (Ferrière) were found parasitising the closely related *Plesispa nipae* Maulik in Malaya and attacked the eggs and pupae, respectively, of *B. mariana* when tested in Saipan. Both were released on Saipan and Rota, *Tetrastichus* mainly from material obtained from Java, where it was being reared in the laboratory, and the latter had become established on both islands by July 1948, It attacks both larvae and pupae and parasitised about 75 per cent. of the former. *Haeckeliania* did not appear to become established. A predacious earwig, *Chelisoches morio* (F.), is common on coconut in Micronesia and is reported to attack *Brontispa* [*cf.* **23** 548, etc.], but it is probably of negligible importance in control.

Furcaspis oceanica is common throughout the Marshall, Caroline and Mariana Islands, feeds on the leaves of coconut and becomes very abundant when not controlled by parasites. *Anabrolepis oceanica* Doutt was found parasitising it on Ulithi and was introduced into Saipan and released in 1948 [*cf.* **39** 444], but the scale was still abundant in the spring of 1949. *D.f. dorsalis* has spread to several islands in Micronesia, including Saipan, Tinian and Guam [*cf.* **38** 75]. Bagging the fruits before they are ripe and clean cultivation have given the best control, and efforts are being made to introduce parasites. Other natural enemies introduced include the predacious Histerid, *Plaesius javanus* Erichson, a consignment of which was obtained from Fiji in 1947 and released on Guam against *Cosmopolites sordidus* (Germ.) on banana. It appeared to have become established.

Lantana camara, an introduced noxious weed, has spread to Ponape (eastern Carolines), and in August 1948 consignments of *Crocidosema lantana* Busck, *Platyptilia pusillidactyla* (Wlk.), *Teleonemia scrupulosa* Stål (*lantanae* Dist.) and *Agromyza lantanae* Frogg. were obtained from Hawaii and released against it. The last two, and possibly *Platyptilia*, appeared to have become established by early 1949.